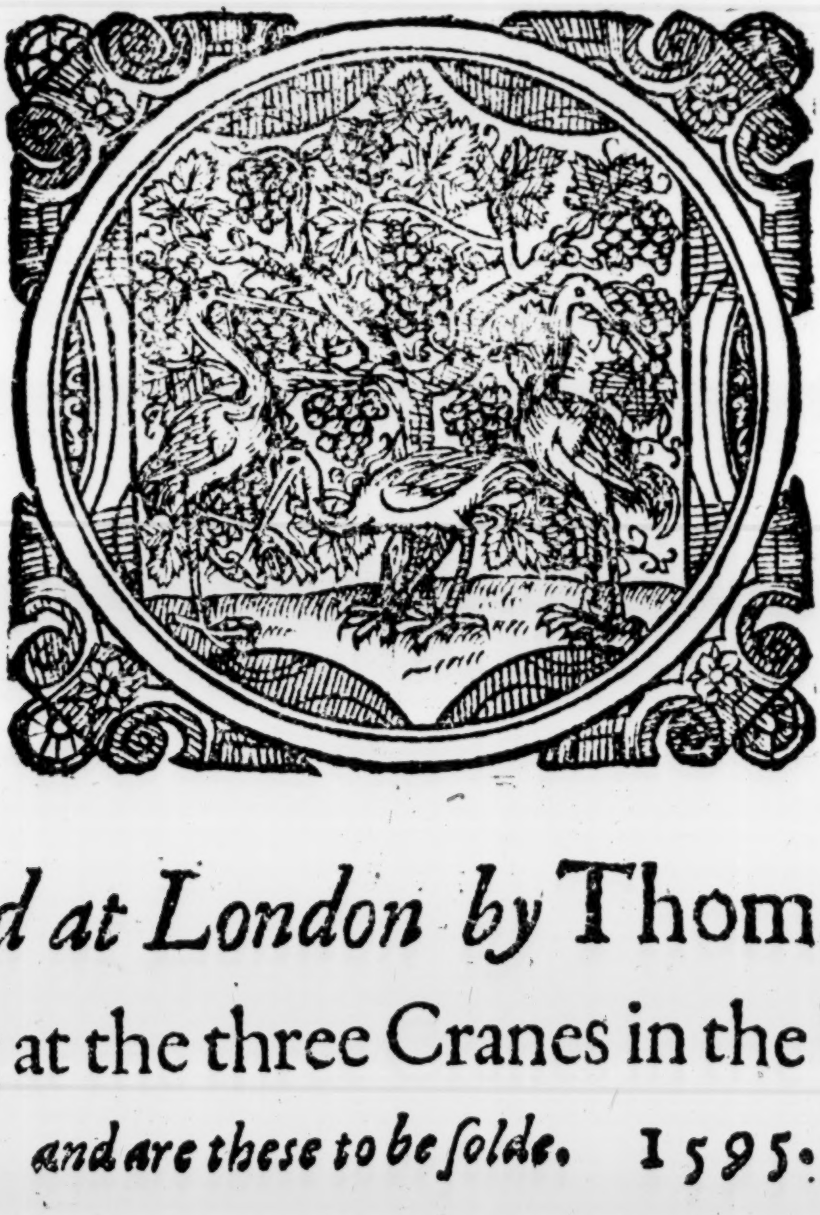
THE SEAMANS SECRETS.

Deuided into 2. partes, wherein is taught the
three kindes of Sayling, Horizontall, P~~e~~aradoxall, and ſayling vpon
a great Circle: alſo an Horizontall Tyde Table for the eaſie finding
of the ebbing and flowing of the Tydes, with a Regiment newly calculated
lated for the finding of the Declination of the Sunne, and many
other moſt neceſſary rules and Inſtruments, not
heeretofore ſet foorth by any.

Newly publiſhed by *Iohn Dauis* of *Sandrudge*, neere
Dartmouth, in the County of *Deuon*. Gent.



¶ *Imprinted at London by* Thomas Dawſon,
dwelling at the three Cranes in the Vinetree,
and are there to be ſolde. 1595.

To the right honorable Lord Charles Haward,
Baron of *Effingham*, Knight of the noble order of the
Garter, Liuetenant of her Maieſties Counties of Suſſex and Surrey.
Conſtable of her Maieſties Honor and Caſtle of Win-
ſor, Lord high Admirall of England, Ireland, and VVales, and of the
Dominions and Iſles of the ſame, of the Towne of Callis and
marches thereof, Normandy, Gaſcony, and Geynes, Captaine
generall of her Maieſties Seas and Nauie royall, and one of
her Maieſties moſt honorable priuie Counſell. Iohn Dauis
wiſheth increaſe of honour and
perfect felicitie.

Right Honourable and my eſpeciall good Lord, as by the inſtinct of nature all men are deſirous of knowledge, and take pleaſure in the varieties of vnderſtanding, ſo it is likewiſe ingraffed by the ſame benefit of nature, in the harts of true nobilitie, not onely to excell the vulgare ſort, but alſo to cherriſh, ſupport, and countenance all ſuch as ſhall in due courſe proſecute their vocation: and as ſuch practiſes either ſpeculatiue or mecanicall, ſhall receiue fauourable place in the honourable opinion of nobilitie, by ſo much the more ſhall the practiſer be eſteemed: which is the cauſe that at this time imboldneth me, to preſent vnto your moſt honourable fauour this ſmal treatiſe of Nauigation, being a breefe collection of ſuch practiſes as in my ſeuerall voyages I haue from experience collected Among which in my three ſeuerall attempts for the diſcouery of the Northweſt paſſage, thereby to finde a ſhorte and nauigable courſe vnto the riche and famous Countries of *Cathayo, China, Pegu*, the Iſles of *Molucan* and *Phillipina*, that thereby to the great and ineſtimable benefite of our Countrie, there might be a rich and plentifull trade procured betweene vs and the ſaid nations in ſhort time to be perfourmed, and with great ſafetie in regarde of the courſe: which action and diſcouery (by meanes of that honourable Counſeller Sir *Fraunces Walſingham* Knight, principall Secretary to her Maieſtie) was with good reſolution accepted by the Merchants of London, but in the decay of his honourable life, the attempt was likewiſe quailed: but howſoeuer mens mindes alter, yet vndoubtedly there is a paſſage nauigable, and eaſie to be perfourmed by that courſe (whenſoeuer it ſhall pleaſe God to reueale the ſame) by inuincible reaſons, and ſufficient experience to be proued: and although before I entred into that diſcouery, I was ſufficiently perſwaded of the certaintie thereof, by hiſtoricall relation ſubſtantially confirmed, whereof to the aduentures I made ſufficient proofe, but eſpecially to my worſhipfull good freend Maſter *William Sanderſon*, the onely Merchant, that to his great charges with moſt conſtant trauaile did labour for the finiſhing thereof: yet I thanke God that of late it hath beene my very good chaunce to receiue better aſſurance then euer before of the certaintie of that paſſage, and ſuch was my vehement deſire for the perfourmance thereof, that thereby I was onely induced to goe with M. *Candiſhe* in his ſecond attempt for the South Seas, vpon his conſtant promiſe vnto me, that when we came to the *Callifornia*, I ſhould there haue his Pinnice with my owne Barck (which for that purpoſe went with me to my great charges) to ſearch that Northweſt diſcouery vpon thoſe backe partes of *America*, but God hath otherwiſe diſpoſed our purpoſes in his deuine Iudgements, for M. *Candiſhe* being halfe way through the ſtraights of *Magilane*, and impatient of the tempeſtious furiouſnes of that place, hauing all his Ships and company with him, returned for *Braſill*, by the authoritie of his commaund, whē with a leading winde we might haue paſſed the ſame, and returning more then 80. leages toward *Braſill*, my ſelfe being in his Ship named the *Deſire*, without Boate, Oares, Sayles, Cables, cordage, victuals, or health of my companye ſufficient for that attempt, was ſeperated in a frette of weather, and forced to ſeeke the nex ſhorte for my releefe, and recouering a harborow by vs named Port Deſire, being in the lati. of 48. deg. did there repaire my moſt miſerable wantes, and there ſtaying foure monethes in moſt lamentable diſtreſſe, did againe conclude with my company to giue an other attempt to paſſe the ſtraights, as my beſt meane to gaine releefe. And three times I was in the South Seas, but ſtill by furious weather forced back againe: yet notwithſtanding all this my labour to perfourme the voyage for his profite, and to ſaue my ſelfe, (for I did aduenture and my good freends for my ſake 1100. pounds in the action.) M. *Candiſhe* was content to account me to be the authour of his ouerthrowe, and to write with his dying hand that I ranne from him, when as his owne Ship was returned many monethes before me,

I am bolde to make this relation vnto your Lordſhip, onelye to ſatisfie your Honour of my conuerſation, for were I faultie of ſo foule a crime, I were worthy of tenne thouſand tormentes, in preſuming to preſent this Treatiſe to your honourable Lordſhip, and now referring my cauſe to your Lordſhips conſideration, I will againe returne to my purpoſe.

In thoſe Northweſt voyages where Nauigation muſt be executed in moſt exquiſite ſorte, in thoſe attempts I was enforced to ſearch all poſſible meanes required in ſayling, by which occaſion I haue gathered together this breeſe treatiſe, which with my ſelfe I doe dedicate to your moſt honourable protection, being deſirous if it lay in my power, to doe farre greater matters in your Lordſhips ſeruice, hoping of your honourable pardon, becauſe it is onely done to ſhewe my dutifull affection, and not for any ſingularitie that the worke containeth. For I thinke there be many hundreds in England that can in a farre greater meaſure and more excellent methode expreſſe the noble arte of Nauigation, and I am fully perſwaded that our Countrie is not inferiour to any for men of rare knowledge, ſinguler application, and exquiſite execution of the Artes Mathematick, for what Strangers may be compared with M. *Thomas Digges* Eſquire, our Countryman the great maſter of Archmaſtrie, and for Thericall ſpeculations and moſt cunning calculation M. *Dee* and M. *Thomas Heriotts* are hardly to be matched: and for the mecanicall practiſes drawne from the Artes Mathematick, our Countrie doth yeelde men of principall excellencie, as M. *Emery Mulleneux* for the exquiſite making of Globus bodies, and M. *Nicholas Hellyar* for the ſingularitie of portrature ~~hath~~ haue the praiſe of Europe, M. *Baker* for his skill and ſurpaſſing grounded knowledge for the building of Ships aduantageable to all purpoſe, hath not in any nation his equall.

And now that I may returne to the painefull Seaman, it is not vnknowne to all nations of the earth, that the Engliſh goeth before all others in the practiſes of ſayling, as appeareth by the excellent diſcouery of Sir *Fraunces Drake*, in his paſſage through the ſtraights of Magilane, which being then ſo rawly knowne, he could not haue paſſed, vnleſſe he had beene a man of great practiſe and rare reſolution: ſo much I may boldely ſay, becauſe I haue ſeene and taſted the frowardnes of the place, with the great vnlikelyhoode of any paſſage to be that way.

I might heere repeate the moſt valiant and excellent attemps of Sir *Hugh Willougbie*, Sir *Iohn Hawkins*, Sir *Humfry Gilbert*, and your Lordſhips ſeruant M. *George Raymond*, with diuers others that haue giuen moſt reſolute attempts in the practiſes of Nauigation, as well for the diſcouery as other execution, whereby good proofe is made, that not onely in the skill of Nauigation, but alſo in the mecanicall execution of the practiſes of ſayling, we are not to be matched by any nation of the earth.

And ſith Nauigation is the meane whereby Countries are diſcouered, and comunitie drawne betweene nation and nation, the word of God publiſhed to the bleſſed recouery of the forraine caſtes from whome it hath pleaſed his deuine Maieſtie as yet to detaine the brighnes of his glory: and that by nauigation common weales through mutuall trade are not onely ſuſtened, but mightily enriched, [illegible] how greatly [illegible] ought the paynefull seaman to be [illegible] by whoſe hard aduentures ſuch excellent benefites are atchieued, for by his exceeding great hazzards the forme of the earth, the quantities of Countries, the diuerſitie of nations, and the natures of Zones, Climats, countries and people, are apparantly made known vnto vs:

beſides

Beſides, the great benefites mutually interchanged betweene nations, of ſuch fruites, commodities, and artificiall practiſes wherewith God hath bleſſed eche perticular Countrie, coaſt, and nation, according to the nature and ſcituation of the place.

For what hath made the Spaniard to be ſo great a Monarch, the Commaunder of both Indias, to abound in wealth and all natures benefites, but onely the painefull induſtrie of his Subiects by Nauigation: their former trade was onely figs, Orenges, and Oyle, but now through Nauigation it is brought to be golde, ſiluer, pearles, ſilkes, and ſpice, by long and painefull trade recouered. Which great benefites onely by her Maieſties louing clemencie and mercifull fauour he doth poſſeſſe: for if her highnes and her moſt honourable Lords would but regarde the ſmall diſtance betweene her dominions and thoſe famous rich kingdomes, the eaſines of the paſſage being once diſcouered, (the Northweſt I meane) with the full ſufficiencie of her highnes Subiects to effect the ſame, there could then be no doubt but her ſtately ſeate of London ſhould be the ſtorehouſe of Europe, and a nurſſe to all nations, in yeelding all Indian commodities in a farre better condition, and at a more eaſie rate then now brought vnto vs, exchanging commodities of our owne ſtore, with a plentifull returne at the firſte hand, which now by many exchanges are brought vnto vs.

Then ſhould the Spaniard againe returne to his olde trade, and our ſacred Soueraigne be ſeated the Commaunder of the earth: which trade and moſt fortunate diſcouery, we aboue all nations ought moſt principally to regarde, becauſe of the ſingularitie and ~~inuiolable~~ force of our Shipping, which is not onely the commaunding fortreſſe of our Countrie, but alſo the dread of our aduerſary, and glory of our nation: wherein we doe in no ſorte flatter our ſelues, for it was made apparant to all nations of the earth, by the late moſt famous conqueſt that her Maieſtie had againſt the huge ſuppoſed inuincible fleete of the Spaniard, being by her Nauie vnder the commaund of your Lordſhip who there in perſon and in place of her Maieſtie, to your eternall glorious fame did diſgrace their glory, and confound their force, and maniſeſt their weakenes by their daſtardly flight, through Gods prouidence and your Lordſhips ſtately reſolution.

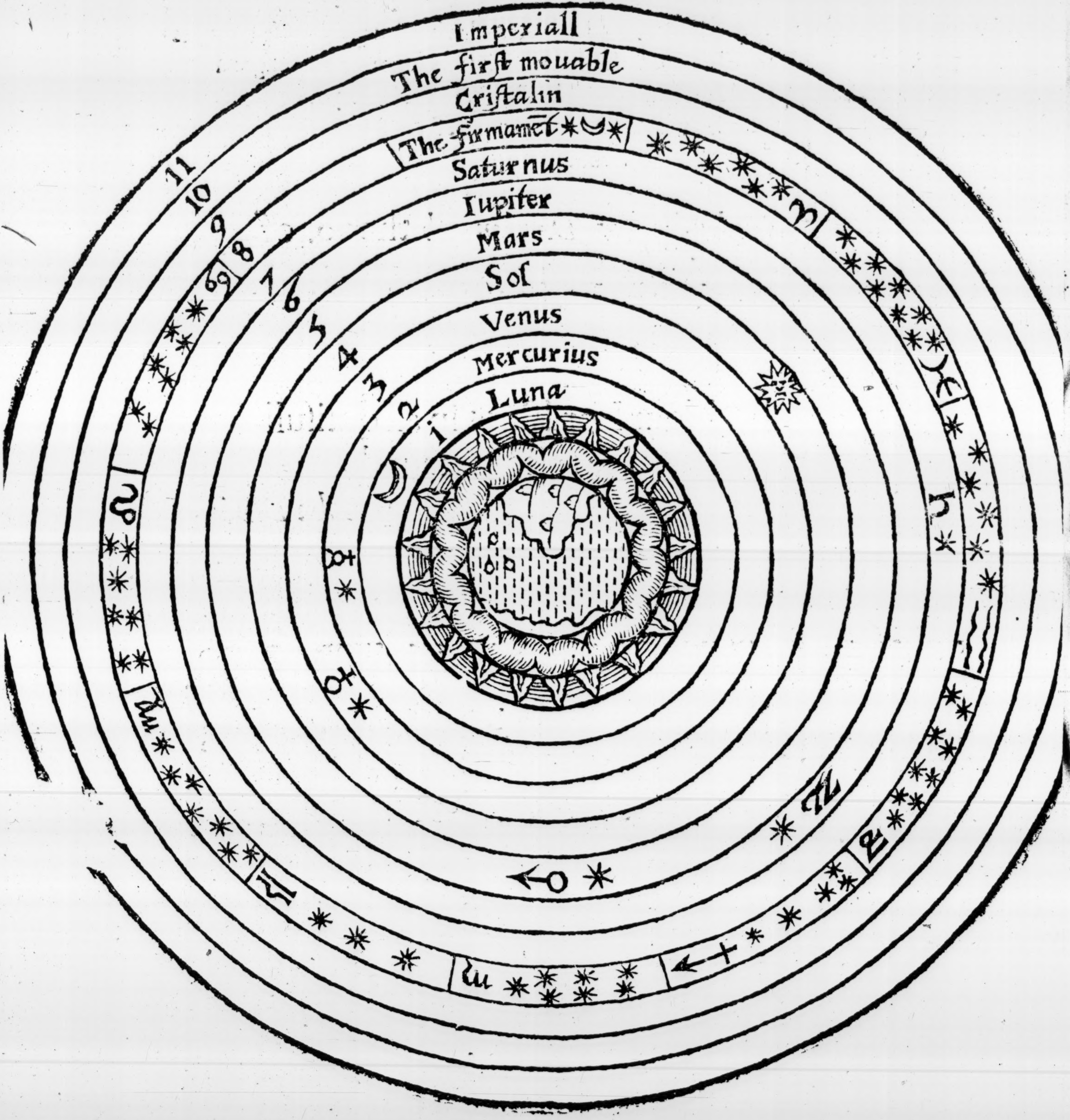
cible

Then ſith Nauigation is a matter of ſo great moment, I ſuppoſe that euery man is bound in dutie to giue his beſt furtherance thereunto: among whome as the moſt vnmeete of all, yet wiſhing all good to the painefull traueller, I haue publiſhed this ſhorte treatiſe, naming it the *Seamans Secrets*, becauſe by certaine queſtions demaunded and anſwered, I haue not omitted any thing that appertaineth to the ſecret of Nauigation, whereby if there may growe any increaſe of knowledge or eaſe in practiſe, it is the thing which I cheefely deſire.

To maniſeſt the neceſſary concluſions of Nauigation in breefe and ſhorte tearmes is my onely intent, and therefore I omit to declare the cauſes of tearmes and diffinition of artificiall wordes, as matters ſuperfluous to my purpoſe, neither haue I laide downe the cunning concluſions apt for Schollers to practiſe vpon the ſhore, but onely thoſe things that are needfullye required in a ſufficient Seaman: beſeeching your honourable Lordſhip to pardon my boldeneſſe, and with your fauourable countenance to regarde my dutifull affection, I moſt humblye commit your good Lordſhip to the mercies of God, who long preſerue your health with continuall increaſe of honour.

From *Sandrudge* by *Darthmouth* the 20. of Auguſt. 1594.

Your Lordſhips in all dutifull
ſeruice to commaund,
Iohn Dauis.


Imperiall
The firſt mouable
Criſtalin
The firmamẽt
Saturnus
Iupiter
Mars
Sol
Venus
Mercurius
Luna
11
10
9
8
7
6
5
4
3
2
1

THE FIRSTE BOOKE OF THE *SEAMANS SECRETS.*

What is Nauigation?

Nauigation is that excellent Arte which demonſtrateth by infallible concluſion, how a ſufficient Ship may be conducted the ſhorteſt good way from place to place, by Corſe and trauers.

What are thoſe infallible concluſions?

Nauigation conſiſteth of three partes, which being well vnderſtood and practiſed, are concluſions infallible, wherby the ſkilfull Pilote is void of all doubt to effett the thing purpoſed. Of which, the firſt is Horizontall Nauigation, which manifeſteth all the varieties of the Ships motion, within the Horizontall plaine ſuperficies, where euery line drawne is ſuppoſed a perallell.

The ſecond is a peradoxall or Coſmographicall Nauigation, which demonſtrateth the true motion of the Ship vpon any courſe aſſigned in longitnde, latitude and diſtance, either perticular or general, and is the ſkilfull gathering together of many Horizontall Corſes, into one infallible and true motion peradoxall.

The third is great Circle Nauigation, which teacheth how vpon a great Circle drawn betweene any 2. places aſſigned, (being the only ſhorteſt way betweene place and place) the Ship may be conducted, and is perfourmed by the ſkilfull application of Horizontall and peradoxall Nauigation.

What is a Corſe?

A Corſe is that peradoxall line which paſſeth betweene place and place, according to the true Horizontall poſition of the Magnet, vpon which line the Ship proſecuting her motion, ſhalbe conducted betweene the ſaide places.

What is a Trauers?

A Trauers is the varietie or alteration of the Ships motion vpon the ſhift of windes, within any Horizontall plaine ſuperficies, by the good collection of which Trauerſes, the ſhips vniforme motion or Corſe is giuen.

What Inſtruments are neceſſary for the execution of this excellent skill?

The Inſtrumentes neceſſary for a ſkilfull Seaman, are a Sea Compaſſe, a Croſſe ſtaffe, a Quadrant, an Aſtrolabie, a Chart, an inſtrument magneticall for the finding of the variation of the Compaſſe, an Horizontall plaine Sphere, a Globe, and a paradoxall Compaſſe. By which inſtruments all concluſions and infallible demonſtrations, Hidrographicall, Geographicall, and Coſmographicall, are without controlement of errour to be performed: but the Sea Compaſſe, Chart, and Croſſe ſtaffe, are inſtruments ſufficient for the ſeamans vſe: the Aſtrolabie and Quadrant being inſtruments very vncertaine for Sea obſeruations.

What is the Sea Compaſſe?

The Sea Compaſſe is a principall inſtrument in Nauigation, repreſenting and diſtinguiſhing the Horizon, ſo that the Compaſſe may conueniently be named, an Artificiall Horizon, becauſe by it are manifeſted all the limits and diſtinctions of the Horizon required, to the perfect vſe of Nauigation, which diſtinctions are the 32. points of the Compaſſe, wherby the Horizon is deuided into 32. equall partes, and euery of thoſe points hath his proper name, as in the figure following appeereth. Alſo euery point of the Compaſſe doth containe degrees, minutes, ſeconds, and thirds, &c. Which degrees are called degrees of Azumuth, whereof there are in euery point $11\frac{1}{4}$. ſo that the whole Compaſſe or Horizou containeth 360. degrees of Azumuth, for if you multiplie $11\frac{1}{4}$. degrees, the degrees that ech point containeth, by 32. the points of the Compaſſe, it yeeldeth 360. the degrees of the Compaſſe. And of minutes eche point containeth 45. being $\frac{3}{4}$. of an hower, ſo that the whole Compaſſe is heereby deuided into 24, howers, by which accompt there are in an hower 15. degrees, ſo that euery degree containeth 4. minutes of time, for an hower conſiſting of 60. minutes, hath for his fifteenth part 4. minutes of time, and in euery minute there is 60. ſeconds, and euery ſecond containeth 60. thirds, either in degrees applied to time, or degrees applied to meaſure: ſo that the generall content of the Compaſſe is, 32. points, 360. degrees, and 24. howers, with their minutes, ſeconds, and thirds.

What is the vſe of the 32. points of the Compaſſe?

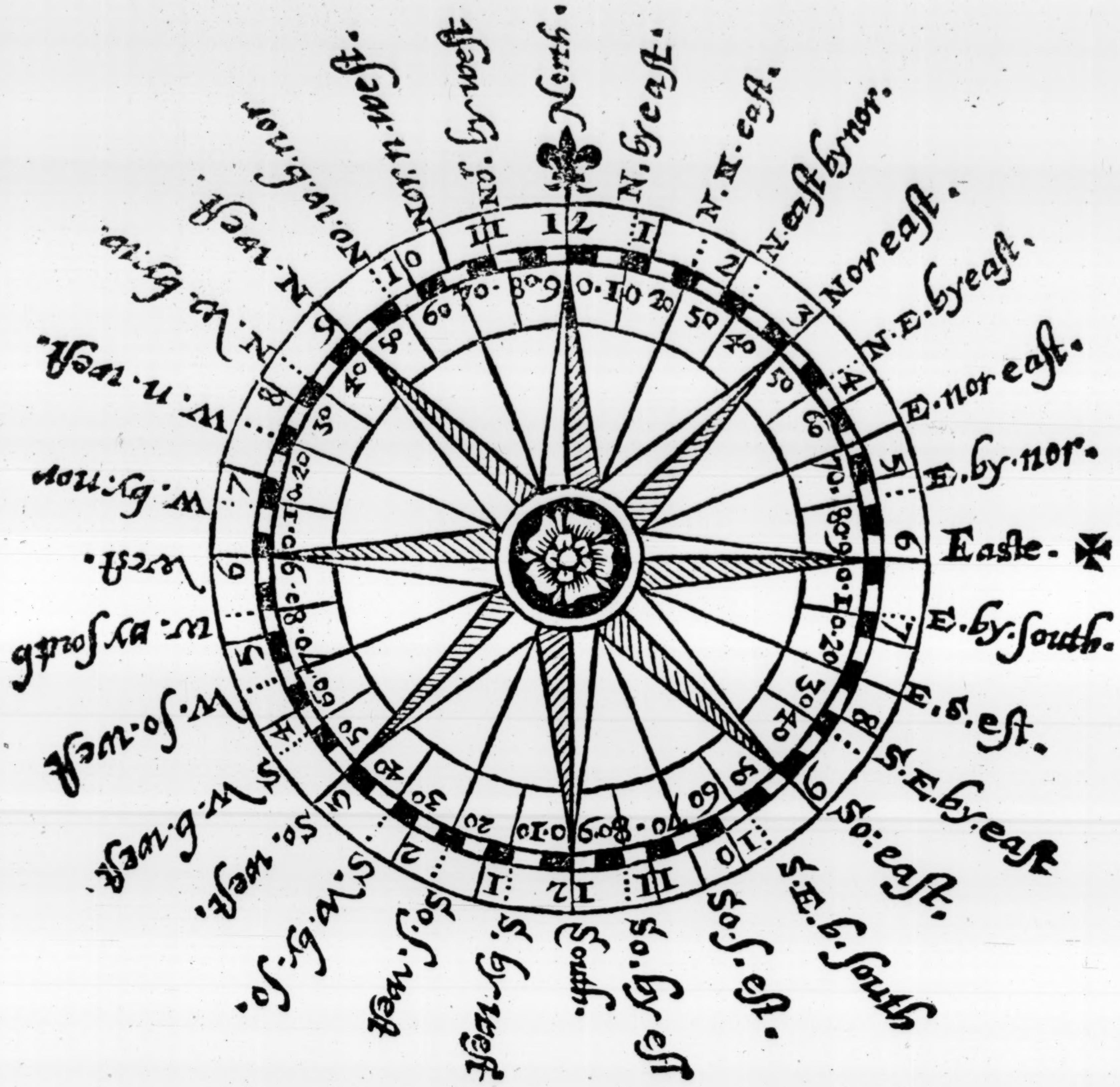
The vſe of the 32. points of the Compaſſe, is to direct the ſkilfull Pilote by Horizontall trauers, how hee may conclude the corſe or paradoxall motion of his Ship, therby with the greater expedition to recouer the place deſired, becauſe they deuide the Horizon into ſuch limits as are moſt apt for Nauigation, they doe alſo diſtinguiſh the windes by their proper names, for the winde receiueth his name by the parte of the Horizon from whence hee bloweth.

What is the vſe of the 360. degrees of Azumuth?

By the degrees of Azumuth is knowne the quantitie of the riſing and ſetting of the Sunne, Moone and Starres, whereby is knowne the length of the dayes and nightes in all climates, and at all times, they alſo ſhew a moſt preciſe Horizontall diſtinction of the motion of the Sunne, Moone and Starres, whereby the certaintie of time is meaſured, and the variation of the Compaſſe, with the Poles height is ingeniouſly knowne at all times and in all places, by helpe of the Globe.

How is the hower of the day knowne by the Compaſſe?

It hath been an ancient cuſtome among Mariners to deuide the Compaſſe into 24. equall partes or howers, by which they haue vſed to diſtinguiſh time, ſuppoſing an Eaſt Sunne to be 6. of the clocke, a Southeaſt Sunne 9. of the clocke, and a South Sunne 12. of the clocke: &c. as in the figure following ſhall plainely appeere. But this accompt is very abſurd, for with vs in England (the Sunne hauing his greateſt North declination,) it is ſomewhat paſt 7. of the clock, at an Eaſt Sunne, and at a Southeaſt Sunne it is paſt 10. of the clocke: alſo when the Sunne is in the Equinoctiall, the Sunne is halfe the day Eaſt, and halfe the day Weſt, to all thoſe that be vnder the ſame, ſo that the Sunne then and to thoſe people vſeth but 2. pointes of the Compaſſe, to perfourme the motion of 12. howers: therfore the diſtinctions of time may not well be giuen by the Compaſſe, vnleſſe the Sunne be vpon the Meridian, or that you be farre toward the North, in ſuch places where the Sunnes Horizontall motion is very oblique, for there the hower may be giuen by the Compaſſe, without any great errour, but elſewhere it cannot. Therefore thoſe that trauaile muſt either vſe the Globe, or an Equinoctiall diall, by whom time may be moſt certainly meaſured, if there bee good conſideration of the variation of the needle by which the Equinoctiall diall is directed, for this is a generall thing to be regarded aſwel in the compaſſe, as in any dials or other inſtrument or concluſion whatſoeuer wherin the vſe of the needle is required, that vnleſſe there be good regarde vnto the variation of the ſame, there can no good concluſion follow of any ſuch practiſes.



What is the next neceſſary thing to be learned?

Hauing perfectly learned the Compaſſe, the next neceſſary thing for a Seaman to know, is the alteration or ſhifting of tydes, that thereby he may with the greater ſafetie bring his Ship into any barred Port, Hauen, Creeke, or other place, where tydes are to be regarded. And this difference of tides in the alteration of flowing and reflowing, is by long experience found to be gouerned by the Moones motion, for in ſuch proportion of time as the Moone doth ſeperate her ſelfe from the Sunne, by the ſwiftnes of her naturall motion: in the like proportion of time doth one tide differ from another, therefore to vnderſtand this difference of the Moones motion, is the onelye meane whereby the time of tides is moſt preciſely knowne.

Of

Of the Moones motion.

YOu muſt vnderſtand the Moone hath two kinde of motions, a naturall motion, and a violent motion, her violent motion is from the eaſt towards the Weſt, cauſed by the violent ſwiftnes of the diurnall motion of primum mobile, in which motion the Moone is caried about the earth in 24. howers and 50. minutes nereſt one day with another, for although the diurnall period of the firſt mouer be perfourmed in 24. howers, yet becauſe the Moone euery day in her ſloweſt naturall motion moueth 12, degrees, therefore ſhe is not carried about the earth, vntill that her motion be alſo caried about, which is in 24. howers and 50. minutes nereſt.

Her naturall motion is from the Weſt towards the Eaſt, contrary to the motion of the firſt mouer, wherein the Moone hath 3. differences of mouing, a ſwift motion, a meane motion, and a ſlowe motion, all which is perfourmed by the diuine ordinance of the Creator, in 27. daies and 8, howers nereſt, through all the degrees af the Zodiac.

Her ſlowe motion is in the point of Auge or apogeo, being then fartheſt diſtant from the earth, and then ſhe moueth in euery day 12. degrees.

Her ſwift motion is in the opoſite of age or perigeo, being then nereſt vnto the earth, at which time ſhe moueth 14. degrees, with ſome ſmall difference of minutes in euery 24. howers.

Betweene thoſe 2. points is her meane motions, and then ſhe moueth 13. degrees nereſt, all which differences are cauſed by the excentricitie of her Orbe wherein ſhe moueth, and are onely perfourmed in the Zodiac, but the Sea men for their better eaſe in the knowledge of tides, haue applied this the Moones motion, to the points, degrees, and minutes of the Compaſſe, whereby they haue framed it to be an Horizontall motion, which ſith by long practiſe is found to be a rule of ſuch certaintie, as that the errour therof bringeth no danger to the expert Seaman, therefore it is not amiſſe to follow their practiſed precepts therein.

In euery 29. daies 12. howers 44 minutes, one with another through the yeere, the Sunne and Moone are in coniunction, and therefore that is the quantitie of time betweene change and change, for although the Moone in 27. daies and 8 howers perfourming her naturall motion, doth returne to the ſame minute of the Zodiac from whence ſhe departed, yet being ſo returned, ſhe doth not finde the Sunne in that parte of the Ecliptick where ſhe lefte him, for the Sunne in his naturall motion mouing euery day one degree towards the Eaſt, is moued ſo farre from the place where the Moone left him, as that the Moone cannot ouertake the Sunne to come in coniunction with him, vntill ſhe haue perfourmed the motion of 2. daies, 4. howers, and 44. minutes nereſt, more then her naturall reuolution, and that is the cauſe wherefore there are 29.daies,12.howers,44 minutes, betweene change & change, one with another through the whole yeere: but the Seaman accompteth the Moones motion,to be vniforme in all places of the Zodiac alike limiting her generall ſeperation from the Sunne, to be ſuch as is her ſloweſt naturall motion,which is 12.degrees,or 48.minutes of time,in euery 24.howers.

By which accompt there are 30. daies reconed betweene change and change,being 11.howers, 16,minutes,more then in truth there is: but becauſe this difference breedeth but ſmal errour in their accompt of tides,therfore to alter practiſed rules where there is no vrgent cauſe,were a matter friuolous,which conſidered,I thinke it not amiſſe that we proceede therein by the ſame methode that commonly is exerciſed.

Allowing the Moone in euery 24.howers to departe from the Sunne 12 degrees,or 48. minutes of time, and in this ſeperation the Moone moueth from the Sunne Eaſtwards,vntill ſhe be at the full,for betweene the change and the full, it is called the Moones ſeperation from the Sunne: for after the full ſhe doth apply towards the Sunne,ſo that betweene the full and the change it is called the Moones application to the Sunne, in which time of application ſhe is to the Weſtward of the Sunne,as in her ſeperation ſhe is to the Eaſtward,or I may ſay in the Seamans phraiſe, all the time of her application ſhe is before the Sunne,and in the time of her ſeperation ſhe is abaft the Sunne.

Then if the Moone doe moue 48.minutes of time in 24.howers, it followeth that ſhe doth moue 24.minutes in 12. howers, and in 6. howers ſhe moueth 12. minutes,therefore euery hower ſhe moueth 2. minutes, and ſuch as is the difference of her motion,ſuch is the alteration of tides, and therfore euery tide differeth from the other 12.minutes, becauſe there is 6.howers betweene tide and tide, and in euery hower the courſe of flowing or reflowing altereth 2.minutes,whereby it appeereth that in 24. howers the foure tides of flowing and reflowing doe differ 48.minutes of time.

And ſith the whole knowledge of this difference or alteration of tides, as alſo the quantitie of the Moones ſeperation and application to and from the Sunne,dependeth vpon the knowledge of the Moones age, it is therfore neceſſary that next you learne how the Sunne may be knowne.

For the perfourmance whereof there are 2 numbers eſpecially required, named the Prime and the Epact,for by the prime the epact is found,and by helpe of the Epact the Moones age is knowne.

Of the prime or Golden number.

The Prime is the ſpace of 19.yeeres,in which time yͤ moone performeth all the varieties of her motion with the ſunne,and at the end of 19. yeres beginneth the ſame reuolution againe, therefore the Prime neuer exceedeth the number of 19. and this prime doth alwaies begin in January, and thus the prime is found: vnto the yeere of the Lord wherein you deſire to know the prime adde 1. then deuide that number by 19. and the remaining number which commeth not into the quotient is the prime. Example, in the yeere of our Lord 1590. I deſire to know the prime, therefore I adde 1. vnto that yeere, and then it is 1591. which I deuide by 19. and it yeeldeth in the quotient 83. and there remaineth 14. vpon the diuiſion, which commeth not into the quotient, which 14. is the prime in the yeere of our Lord 1590.

```
                   1
1590              74
   1            1591
-----            199 (83
1591            1527
                   1
                   5
```

Of the Epact.

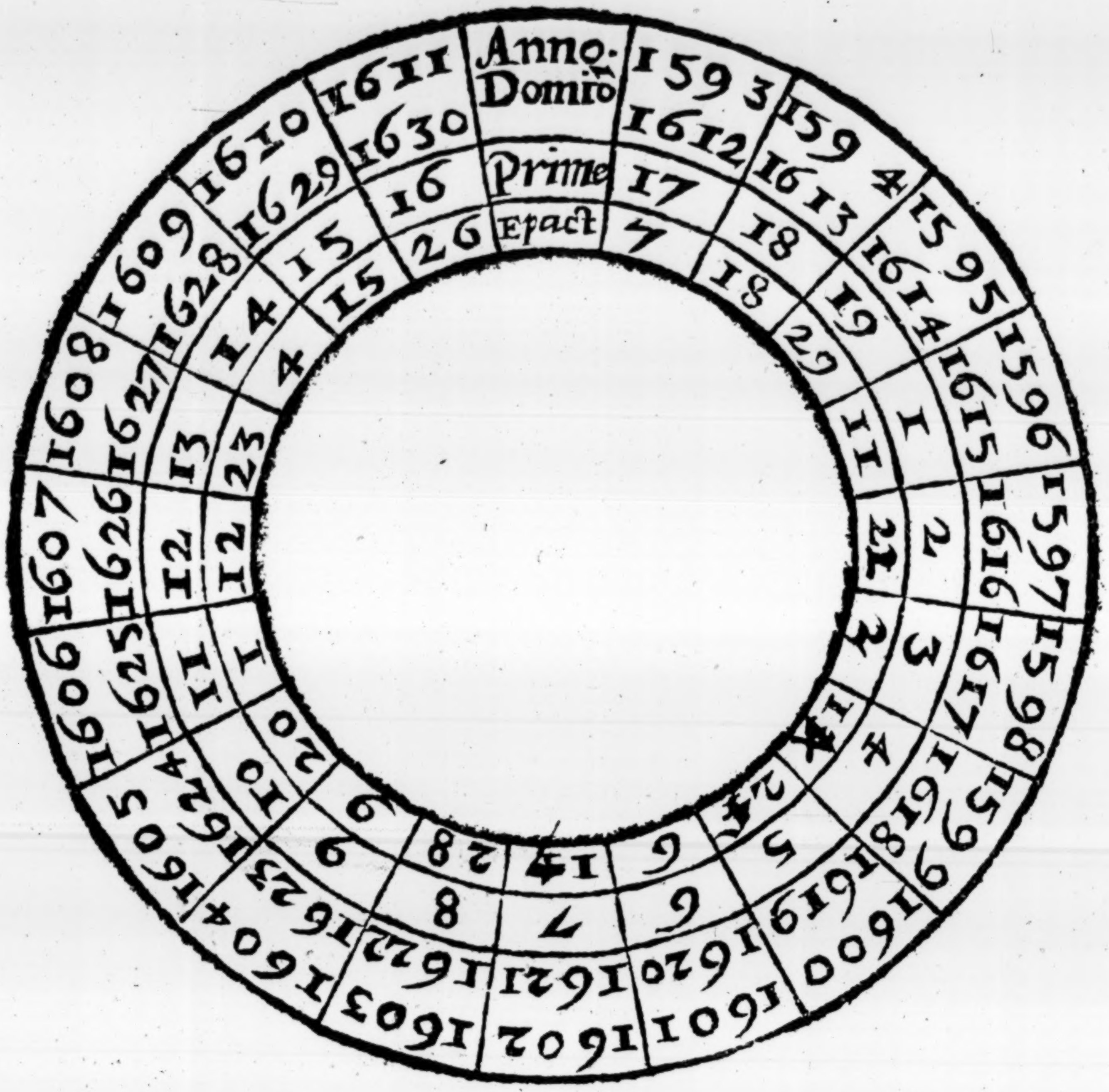
The Epact is a number proceeding from the ouerplus of the ſolar and lunar yeere, which number neuer exceedeth 30. becauſe the Moones age neuer exceedeth 30. for the finding whereof this number onely ſerueth: and thus the Epact is knowne, which Epact doth alwaies begin in March, multiplye the prime by 11. (being the nereſt difference betweene the ſolar and lunar yeere) deuide the product by 30. and the remainer is the epact. Example, in the yeere of our Lord 1590. I would know the Eqact, firſt I ſeeke the prime of that yeere, and finde it to be 14. I therefore multiply 14. by 11. and that yeeldeth 154. which being deuided by 30. it giueth in the quotient 5. and there remaineth 4. vpon the diuiſion, which 4. is the Epact in the yeere 1590. which beginning in March, doth continue vntill the next March of the yeere 1591.

```
 14
 11          15(4
----         130 (5
 14           50
 17
----
154
```

Of the ſolar and lunar yeere.

The ſolar yeere or the Suns yeere conſiſteth of 12. moneths, being 365. daies, and about 6. howers, the lunar yere or yͤ Moones yere containeth 12. Moones, and euery Moone hath 29. daies, 12. howers, 44. minutes nereſt, which amount vnto 354. daies, 5 howers, 28. minutes, the content of the Lunar yeere, which being ſubſtracted from 365 dayes, 6. howers, there reſteth 11. daies and 32. minutes, the difference between the ſaide yeeres, from which difference the Epact commeth.

By this Table the prime and Epact may for euer be found, for when the yeeres be expired, you may begin againe and continue it for euer at your pleaſure.



Anno Domini		Prime	Epact
1593	1612	17	7
1594	1613	18	18
1595	1614	19	29
1596	1615	1	11
1597	1616	2	22
1598	1617	3	3
1599	1618	4	14
1600	1619	5	25
1601	1620	6	6
1602	1621	7	17
1603	1622	8	28
1604	1623	9	9
1605	1624	10	20
1606	1625	11	1
1607	1626	12	12
1608	1627	13	23
1609	1628	14	4
1610	1629	15	15
1611	1630	16	26

The firſt circle containeth the yeeres of our Lord, the ſecond the prime, and the third and inner circle ſheweth the Epact: vnder euery yeere you ſhall finde his prime and Epact, the prime beginneth in January, and the Epact in March.

How to finde the Moones age.

First conſider the day of the moneth wherein you ſeeke the Moones age, then note how many moneths there are betweene the ſaid moneth and March, including both moneths, vnto thoſe numbers adde the Epact of that yeere, that is, you muſt adde into one ſumme the day of the moneth, betweene March and your moneth, reckoning both moneths and the Epact, all which numbers ioyned together, if they exceede not 30. is the moones age, if they be more then 30. caſt away 30. as often as you can, and the remainer is the Moones age, if it be iuſt 30. it is then new Moone, if 7, it is the firſt quarter day,

moneths

day, if 15. it is full Moone, if 22. it is then the laſt quarter day, and thus the Moones age is found for euer.

And now being able for all times either paſt, preſent or to come, to giue the Moones age, I think it good by a few queſtions conuenient for the Seamans practiſe, to make you vnderſtand the neceſſary vſe thereof.

For the accompt of Tydes.

WHen you deſire to know the time of full Sea in any place, at all ſuch ſeaſons as occaſion ſhall require, you muſt firſt learne what moone maketh a full Sea in the ſame place, that is, vpon what point of the Compaſſe the Moone is, when it is full Sea at the ſaid place, you muſt alſo know what hower is appropriated to that point of the Compaſſe, as before is ſhewed: for vpon the change day it will alwaies be full Sea in that place, at the ſame inſtant of time, by which conſiderations you muſt thus proceed for the ſearch of tides.

Multiplie the Moones age by 4. deuide the product by 5. and to the quotient adde the hower which maketh full Sea in that place vpon the change day, if it exceede 12. caſt away 12. as oft as you may, and then the hower of full Sea remaineth, and for euery 1. that reſteth vpon your diuiſion, allow 12. minutes to be added to the howers, for 2, 24. minutes, for 3, 36, and for 4. 48. minutes, for more then 4. will neuer remaine, and thus you may know your tides to a minute. Example, the Moone being twelue daies olde, I deſire to know the time of full Sea at London: firſt it is found by experience, that a Southweſt and Northeaſt Moone make full ſea at London, next, I conſider that 3. of the clocke is the houre appropriated to that point of the Compaſſe, whith number I keepe in memory, then I multiplie the Moones age, being 12. by 4. and that yeeldeth 48. which being deuided by 5. it giueth in the quotient 9. and three remaineth, I adde the quotient 9. to the hower 3. and it maketh 12. howers, and for the remaining number 3. I alſo adde 36. minutes, ſo that I finde when the Moone is 12. daies olde, it is 12. of the clocke, and 36. minutes paſt, at the inſtant of full Sea at London: by this order you may at all places & times know the certaintie of your tides at your pleaſure.

But thoſe that are not practiſed in Arithmetick may accompt their tides in this ſorte, knowing how many daies olde the Moone is, he muſt place the Moone vpon that point of the Compaſſe which maketh full Sea at the place deſired, and then reckoning from that point with the ſunne according to the diurnal motion, muſt accompt ſo many points, and ſo many times 3. minutes as the Moone is daies olde, that is for euery day one point and 3. minuts, and there finding the Sun, he muſt conſider what is the hower allowed to that point where he findeth the Sunne, for that is the hower of full Sea. As for Example, the moone being 12, daies olde, I deſire to know the hower of full

Sea at London, now finding by former experience, that a Southweſt Moone maketh full Sea at London, I therefore place the Moone vpon the point Southweſt, then I accompt from the point Southweſt 12. points, reckoning with the Sunne according to the diurnall motion, Southweſt and by weſt for the firſt pointe, Weſt Southweſt for the ſecond, Weſt by South for the third, Weſt for the fourth point, and ſo forth vntill I come to North, which is 12. points from Southweſt, and becauſe the Moone moueth 3. minutes more then a point in euery day, I therefore adde three times twelue, which make 36. minutes vnto the point North, at which place I finde the Sunne to be, and knowing that twelue of the clocke is appropriated to the point North, I may therfore boldely ſay that at twelue ef the clocke 36. minutes paſt, it is full Sea at London. when the Moone is twelue daies olde, which 36. minutes are added, becauſe the Moone hath moued 36. minutes more then twelue points in thoſe twelue daies, which is one point and 3. minutes for euery day, as before.

Heere followeth a very neceſſary Inſtrument for the knowledge of the Tydes, named an Horizontall tyde Table.

The Seamans Srecets.

Of this Inſtrument and his partes.

This neceſſary inſtrument for the yong practiſing Seamans vſe, namely an Horizontall tyde table, whereby he may ſhift his Sunne and Moone (as they terme it) and know the times of his tides with eaſe and very certainly, beſides the anſwering of many pleaſant and neceſſary queſtions vſed amongſt Mariners) I haue contriued into this methode, onely for the benefite of ſuch yong practiſers in Nauigation.

The firſt parte of this inſtrument is a Sea Compaſſe, deuided into 32. points or equall partes, the innermoſt circle of which Compaſſe is deuided into 24. howers, and euery of thoſe into 4. quarters, eche quarter being 15. minutes, and againſt euery point of the Compaſſe thoſe places are laide downe, in which places it is full Sea when the Moone commeth vpon the ſame point, ſo that whatſoeuer is required as touching time, or the pointes of the Compaſſe, is there to be knowne.

The next moueable circle vpon this Compaſſe, is limited to the Sunne, vpon whoſe index the Sunne is laide downe, which circle is deuided into 30 equall partes or daies, ſignifying the 30. daies between change and change, according to the Seamans accompt, ſo that whatſoeuer is demaunded as touching the age of the Moone, is vpon that circle to be knowne.

The vppermoſt moueable circle is applied to the Moone, vpon whoſe index the Moone is laide downe, which is to be placed either to the points and partes of the Compaſſe, or to the time of her age, as the queſtion requireth: which conſidered, the vſe of this inſtrument is largely manifeſted, by theſe queſtions with their anſweres following.

How to know the hower of the night by the Moone, being vpon any point of the Compaſſe, by this inſtrument.

1. Q. The Moone 10. daies olde, I demaund what it is a clocke, when ſhe is Eaſt Northeaſt.

1. A. In this queſtion the Moones age and the point of the Compaſſe is giuen, therby to know the hower, I therfore place the index of the Moone vpon the point Eaſt Northeaſt, there keeping the ſame not to be moued, then becauſe the Moone is 10. daies olde, I moue the index of the Sunne vntill I bring ẏ tenth day of the Moons age vnto the index of the Moon, and there I looke by the Index of the Sunne and finde vpon the Compaſſe that it is twelue of the clocke at noone and 30. minutes paſt, when the Moone is vpon the point Eaſt Northeaſt, being 10. daies olde,

2. Q. The Moone being twelue daies olde, I demaund at what hower ſhe wilbe vpon the point S. S. E.

2.A. In this queſtion the point of the compas & Moons age is giuen, as in the firſt, therefore I place the index of the Moon vpon the point S.S.E. and there holding it without mouing, I turne the index of the Sunne, vntill the twelfth day of the moones age come to the index of the moone, and then the index of the Sunne ſheweth me vpon the Horizon the hower 8. therefore I ſay that at 8. of the clock at night the moone was then vpon the point South Southeaſt.

And thus you may at al times know the hower of the night by the Moon, vpon any point of the Compaſſe, ſo that the Moones age be alſo had.

How by this Inſtrument, you may know at all times vpon what point of the Compaſſe the Moone is.

1. Q. When the Moone is 10. daies olde, vpon what pointe of the Compaſſe will ſhe be, at 9. of the clocke in the morning?

1. A. In this queſtion the houre of the day and the Moones age is giuen, thereby to finde vpon what point of the Compaſſe ſhe is at the ſame time. I therefore place the Index of the Sunne vpon the Compaſſe, at the houre 9. of the clocke in the morning, being vpon the point Southeaſt, then I turne the Index of the Moone, vntill I bring it to the tenth day of her age, and then I ſee vpon the Compaſſe that the Moone is North and by eaſt, and 15. minutes to the Eaſtwards, at 9. of the clocke when ſhe is 10. daies olde.

2. Q. When the Moone is 20. daies olde, vpon what point of the Compas will ſhe be at 2. of the clocke in the after noone?

2. A. I place the Index of the Sunne vpon the hower 2. noted in the compaſſe, there holding the ſame without mouing, then I turne the Index of the Moone, vntill I bring it vnto the twentith day of her age, and there I ſee vpon the Compaſſe that ſhe is Northeaſt and by north, and 15. minutes to the Northward, at 2. of the clocke in the afternoone, when ſhe is 20. daies olde.

To finde the Moones age by this inſtrument.

1. Q. When the Moone is North at 7. of the clocke in the forenoone, how olde is ſhe?

1. A. In this queſtion the point of the Compaſſe and the hower is giuen for the finding of the Moones age: therefore I ſet the Index of the Sunne vpon the hower 7. in the forenoone, there holding it without mouing, then I bring the Index of the Moone to the point North, and then vpon the circle containing the daies of the Moones age, I ſee the Moone is 8. daies and about 18. howers olde, when ſhe is North at 7. of the clocke in the forenoone.

2. Q. When the Sunne is Eaſt and the Moone Southweſt, how olde is the Moone?

2. A. In

2. A. In this queſtion the points of the Compaſſe are onely giuen for the finding of the Moones age, therefore I ſet the Index of the Sunne vpon the point Eaſt, there holding him ſtedie, then I put the Index of the Moone vpon the point Southweſt, and there I ſee that the moone is 18. daies and 18 howers olde, when the Sunne is Eaſt, and ſhe Southweſt.

After this order by the varietie of theſe fewe queſtions, you may frame vnto your ſelfe many other pleaſant and neceſſary queſtions, which are very eaſily anſwered by this Inſtrument: and entring into the reaſons of their anſweres, you may very readily by a little practiſe, be able by memorye to anſwere all ſuch queſtions with eaſe.

How to know the times of your tides by this inſtrument.

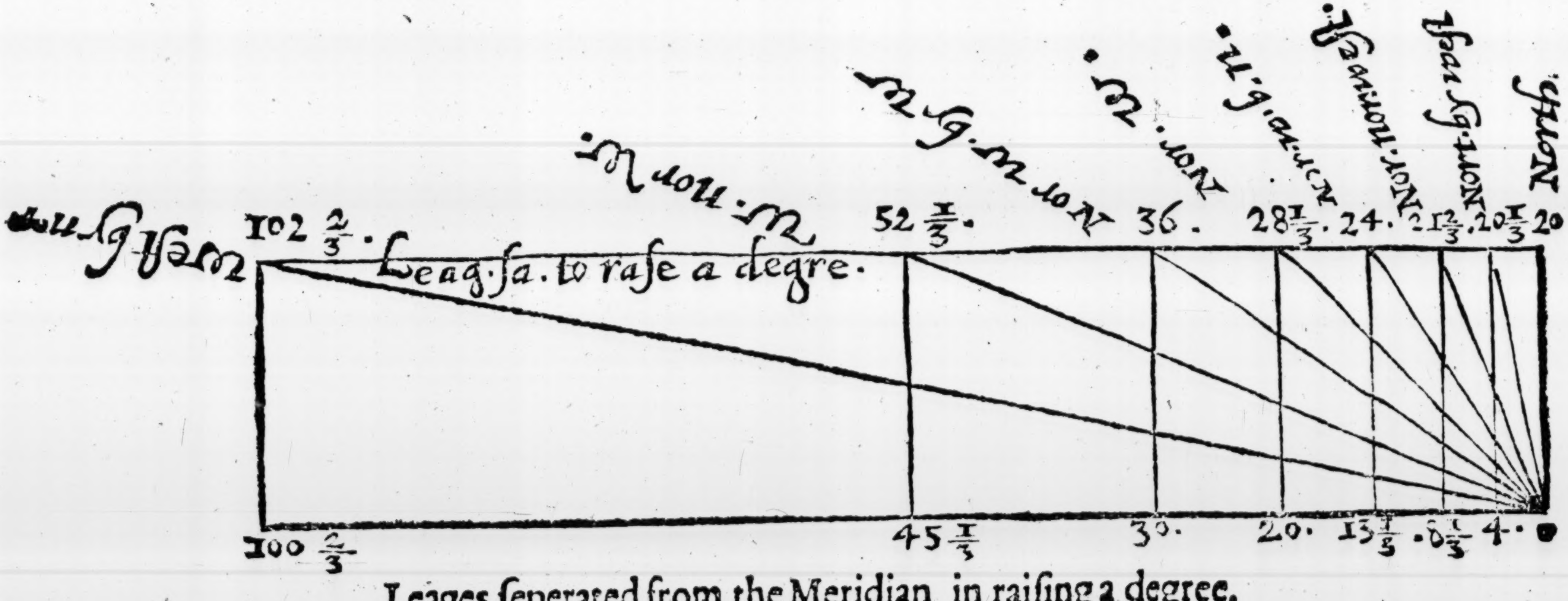
1. Q. When the Moone is 12. daies olde, I deſire to know the time of full Sea at London.

1. A. To anſwere this queſtion, I firſt looke through all the pointes of the Compaſſe of my inſtrument, vntill I finde where London is written, for when the Moone commeth vpon that point of the Compaſſe, it will then be full Sea at London: therfore I place the index of the Moone vpon the ſame point, which I finde to be Southweſt or Northeaſt, there holding the index not to be moued, then I turne the index of the Sunne vntill I bring the twelfth daye of the Moones age to the Index of the Moone, and then the index of the Sunne ſheweth me that at 12. of the clocke 36. minutes paſt, it is full Sea at London, the Moone being 12. daies olde.

2. Q. The Moone being 21. daies olde, at what time is it full Sea at Dartmouth?

2. A. I finde vpon my inſtrument, that Dartmouth is noted vpon the points Eaſt and Weſt, whereby I know that when the Moone is Eaſt or Weſt it is alwaies full Sea at Dartmouth: therefore I place the Index of the Moone vpon the pointe Eaſt, and there holding it without mouing, I turne the Index of the Sunne vntill I bring the 21. day of the Moones age vnto the Index of the Moone, and then the Index of the Sunne ſheweth me vpon the Compaſſe, that at 10. of the clocke and 48. minutes paſt, it is full Sea at Dartmouth, when the Moone is 21. daies olde, and not onelye at Dartmouth, but my inſtrument ſheweth me that at the ſame inſtant it is alſo full Sea at Exmouth, Weymouth, Plymouth, Mounts bay, at Lynne, and at Homber: and thus with great facilitie the time of flowings and reflowings is moſt preciſely knowne.

And now that there may be a finall ende of the vſes and effectes of the Compaſſe, it is conuenient that I make knowne vnto you, how many leages ſhalbe ſailed vpon euery perticular point of the Compaſſe, for the raiſing or laying of the degrees of latitude, and in the diſtance ſayling how farre you ſhall be ſeperated from the Meridian from whence the ſaide courſes are begun, for as euery point of the Compaſſe hath his certaine limited diſtance for the degrees of the Poles eleuation, ſo they doe likewiſe leade from longitude to longitude, euery point according to his ratable limits, which diſtances of leages are without alteration, keeping one and the ſame proportion in euery perticular Horizon of any latitude, but the degrees of Longitude anſwerable to ſuch diſtances, doe differ in euery altitude, according to the nature of of the perallell, as hereafter ſhalbe more plainly manifeſted. And now know, that in ſayling North and South, you departe not from your Meridian, and in euery 20. leages ſayling you raiſe a degree: Nor and by eaſt raiſeth a degree in ſayling 20. leages and one mile, and leadeth from the Meridian 4. leages: Nor noreaſt raiſeth a degree in ſayling 21. leages and two miles, leadeth from the Meridian 8. leages & one mile: Noreaſt by norht raiſeth a degree in ſayling 24. leages, and leadeth from the Meridian 13. leages and a mile: Noreaſt raiſeth a degree in ſayling 28. leages and a mile, and leadeth from the Meridian 20. leages: Noreaſt by eaſt raiſeth a degree in ſaling 36 leages, and leadeth from the Meridian 30. leages. Eaſt noreaſt rayſeth a degree in ſayling 52. leages and a mile, and leadeth from the meridian 48. leags and 2 mile: Eaſt and by north raiſeth a degree in ſayling 102. leages and a mile, and leadeth from the Meridian 100. leages and 2, mile: Eaſt and Weſt doe not raiſe or lay the Pole, but keepeth ſtill in the ſame perallell: the like allowance is to be giuen to euery quarter of the Compaſſe, as is laide downe vpon this Northeaſt quarter.



Leages ſeperated from the Meridian in raiſing a degree.

Q. I perceiue that degrees are to great purpoſe in Nauigation,
What is a degree?

An. IT is moſt true, that degrees are of very great imployment in Nauigation, and a degree is the 360. part of a circle, how big or little ſoeuer the circle be, being applied after 6. ſeuerall ſortes, for the better perfections of the practiſes Gubernautick, ſo ẏ there be degrees of longitude, degrees of latitude, degrees of Azumuth, degrees of altitude, degrees applied to meaſure, and degrees applied to time.

A degree of longitude is the 360. parte of the Equinoctiall.

A degree of latitude is the 360. parte of the Meridian.

A degree of Azumuth is the 360. parte of the Compaſſe or Horizon.

A degree of altitude is the 90. parte of the verticall circle, or the 90. parte of the diſtance betweene the Zenith and the Horizon.

Euery degree applied to meaſure, doth containe 60. minutes, and euery minute 60. ſeconds, and euery ſecond 60. thirds, &c, and euery degree of a great circle ſo applied, containeth 20. leages, which is 60. mile, ſo that euery minute ſtandeth for a mile in the accompt of meaſure, and a mile is limited to be 1000. paces, euery pace 5. foote, euery foote 12. inches, and euery inch 3. barly cornes drye and round, after our Engliſh accompt, which for the vſe of Nauigation is the onely beſt of all other: ſo by theſe rates of meaſure you may proue that a degree is 20 leages or 60. miles, a minute is a mile or 5000. feete, a ſecond is $83\frac{2}{3}$. feete, and a third is $16\frac{2}{3}$. inches: and thus much of degrees and their partes applied to meaſure.

Of degrees applied to time, there are 15. contained in euery hower, ſo that euery degree of time ſtandeth in the accompt of time for 4. minutes, for an hower conſiſting of 60. minutes of time, hath for his fifteenth parte 4. minutes, ſo that a degree being the fifteenth parte of an hower, containeth 4. minutes of time, ſo that 15. degrees or 60. minutes make an hower, 24. howers make a naturall day, and 365. daies 6. howers, are contained in a yeere, and thus much as touching time, and degrees applied to time.

What is the vſe of degrees?

THe vſe of degrees is to meaſure diſtances betweene place and place, to finde altitudes, latitudes, and longitudes, to deſcribe countries, to diſtinguiſh courſes, to finde the variation of the Compaſſe, to meaſure time, to finde the places and motions of all celeſtiall bodies, as the Sunne, Moone, Planets and Starres: to conclude, by degrees haue beene perfourmed all mathematicall obſeruations whatſoeuer, whoſe vſe is infinite.

What is the Poles altitude, and how may it be knowne?

ALtitude is the diſtance, height, or mounting of one thing aboue another, ſo that the altitude of the pole, is the diſtance, height, or mounting of the pole from the horizon, and is defined to be that portion of the meridian, which is contained betweene the Pole and the Horiſon, which altitude or eleuation is to be found either by the Sunne, or by the fixed Starres, with the helpe of your Croſſe ſtaffe, Quadrant, or Aſtrolabie, but the croſſe ſtaffe is the onely beſt inſtrument for the Sea mans vſe.

And in the obſeruation of this altitude there are 5. things eſpecially to be regarded: the firſt is, that you know the meridionall diſtance between your Zenith and the Sunne or Starres, which by your Croſſe ſtaffe or Aſtrolabye is giuen: the ſecond, that the declination be truelye knowne at the time of your obſeruation. And the other three are, that you conſider whether your Zenith be betweene the Equinoctiall and the ſunne or Starres, or whether the Equinoctiall be betweene your Zenith and them, or whether they be between your Zenith and the Equator, for there is a ſeuerall order of working vpon eche of theſe three differences.

Latitude you muſt alſo know, that ſo much as the Pole is aboue the Horizon, ſo much is the Zenith from the Equinoctial, and this diſtance between the Zenith and the Equator is called latitude or widenes. and is that portion of the Meridian which is included betweene your Zenith and the Equator, for it is a generall rule for euer, that ſo much as the Pole is aboue the Horizon, ſo much the Zenith is from the Equinoctiall, ſo that in this ſence altitude and latitude is all one thing, the one hauing relation to that parte of the Meridian contained betweene the pole and the Horizon, and the other to that parte of the Meridian which is contained betweene the Zenith and the ~~vpon~~ Equinoctiall.

You muſt further vnderſtand, that betweene the Zenith and Horizon it is a quarter of a great circle, containing 90. degrees, ſo that knowing how much the ſunne or any Starre is from the Horizon, if you take that diſtance from 90. the remainer is the diſtance betweene the ſaid body and the Zenith: as for example, if the Sunne be 40, degrees 37. minutes from the Horizon, I ſubſtract 40. deg. 37. min. from 90. and there remaineth 49. deg. 23. min. which is the diſtance betweene my Zenith and the Sunne, &c. Thoſe inſtruments that begin the accompt of their degrees at the Zenith concluding 90. in the Horizon, are of moſt eaſe for the finding of the latitude by the Sunne or fixed Starres, becauſe they giue the diſtance betweene the Zenith and the body obſerued, without further trouble, and that is the number which you muſt haue, and for which you do ſearch in your obſeruation: all which things conſidered, you muſt in this ſorte proceede for the finding of the Poles height or altitude.

By the Sunne or fixed Starres being betweene your Zenith and the Equinoctiall the latitude is thus found, in what parte of the worlde ſoeuer you be.

FIrſt place the Croſſe ſtaffe to your eye, in ſuch good ſorte as that there may grow no errour by the diſorderly vſing thereof, for vnleſſe the Center of your ſtaffe and the center of your ſight doe ioyne together in your obſeruation, it will be erronious whatſoeuer you conclude thereby: your ſtaffe ſo ordered, then mooue the tranſuerſary vpon your ſtaffe to and fro as occaſion requireth, vntil at one & the ſame inſtant you may ſee by the vpper edge of your tranſuerſary halfe the body of the Sunne or Starres, and that the lower edge or ende thereof do likewiſe touch the Horizon, at that place where it ſeemeth that the Skye and ſeas are ioyned, hauing eſpeciall regarde in this your obſeruation, that you holde the tranſuerſary as directly vpright as poſſibly you may, and you muſt begin this obſeruation ſomwhat before the Sun or Starres be at South, and continue the ſame ſo long as you perceiue that they riſe: for when they are at the higheſt then are they vpon the Meridian, and then you haue the meridionall altitude which you ſeeke, at which time they will be due South from you, if your Compaſſe be good and without variation, and then doth the tranſuerſary ſhew vpon the ſtaffe the degrees and minutes that the ſaid body is from your Zenith, if the degrees of your inſtrument be numbred from the Zenith toward the Horizon: or elſe it ſheweth the diſtance betweene the ſaide body & the Horizon, if the degrees of your inſtrument be numbred from the Horizon, concluding 90. in the Zenith as commonlye Croſſe ſtaues are marked, which is not the eaſieſt way: but if your ſtaffe be accompted from the Horizon, then ſubſtract the degrees of your obſeruation from 90. and the remainer ſheweth the diſtance betweene your Zenith and the Sunne or Stares, which is the number you muſt know: vnto that number ſo knowne by your inſtrument, adde the declination of the bodye by which you doe obſerue, whether it be the Sun or any ſtar, and that which commeth by the addition of thoſe 2. numbers together, is the poles height, or the latitude of the place wherein you are: as for Example. In the yeere of our Lord 1593. the 3. day of March, the Sunne being then betweene my Zenith and the Equinoctiall, I obſerued the Sunnes Meridionall altitude from the Horizon to be 72. deg. and 20. min. but becauſe I muſt know the diſtance of the Sun from my Zenith, I therefore ſubſtract 72. deg. 20 min. from 90. deg. and there remaineth 17. deg. 40. min. the diſtance of the Sunne from my Zenith, to that diſtance I adde the Sunnes declination for that day, which by my Regiment I finde to be 3. degrees of South declination, and it amounteth vnto 20. deg. 40. min. ſo much is the South pole aboue the Horizon, and ſo much is my Zenith ſouth from the Equinoctiall, becauſe the Sun hauing South declination, and being betweene me and the Equinoctiall, therefore of neceſſitie the Antartick pole muſt be aboue my Horiſon.

89—60—the diſtance betwene the Zenith and the Horizon.
72—20—the Sunnes altitude.

17—40—the Suns diſt. from ẏ Zen.
3—00—Sunnes declination.

20—40—Poles height.

When the Equinoctiall is betweene your Zenith and the Sunne or Starres, the latitude is thus found in all places.

By your inſtrument as before is taught, you muſt ſeek the meridionall diſtance of the Sunne or Starres from your Zenith, which being knowne, ſubſtract the declination of the Sun or Stars from the ſaid diſtance, and the remaining number is the poles height or latitude which you ſeek: Example.

The 20. of October 1593. I finde by my inſtrument that the Sun is 60 deg. 45. min. from my Zenith at noone, being then vpon the Meridian, the Equator being then betweene my Zenith and the Sun, I alſo finde by my Regiment that at that time the Sun had 13. deg. 47. min. of South declination, becauſe the Equinoctiall is betweene me and the Sun, therefore I ſubſtract the Suns declination from the obſerued diſtance, and there reſteth 46 deg. 58. min. the latitude deſired, and becauſe the Sun hath South declination, and the Equinoctiall being betweene me and the Sun, therefore I may conclude, that the pole Artick is 46. deg. 58. min. aboue my Horizon, or that my Zenith is ſo much toward the North from the Equator.

g m
59.—15.—the Sunnes diſtance.
13—47—the declination.

46—58—the latitude.

When your Zenith is betweene the Sunne or Starres and the Equinoctiall, the Latitude is thus found.

By your inſtrument as in the firſt example is ſhewed, you muſt obſerue the Meridionall diſtance of the Sunne or Starres from your Zenith, you muſt alſo by your Regiment or other tables, ſearch to know the declination of that body which you obſerue, then ſubſtract the obſerued diſtance from your Zenith out of the declination, and the remaining number is the latitude deſired: Example. The Sun hauing 20. deg. of North declination, and being vpon the Meridian is 5. deg. 9. min. from my Zenith, I therfore ſubſtract 5. deg. 9. min. from 20. deg. and there reſteth 14. deg. 51. min the latitude deſired: and becauſe the Sun hath North declination, my Zenith being between the Sun and the Equinoctiall, therefore I conclude that the North Pole is 14. deg. 51. min. aboue my Horizon.

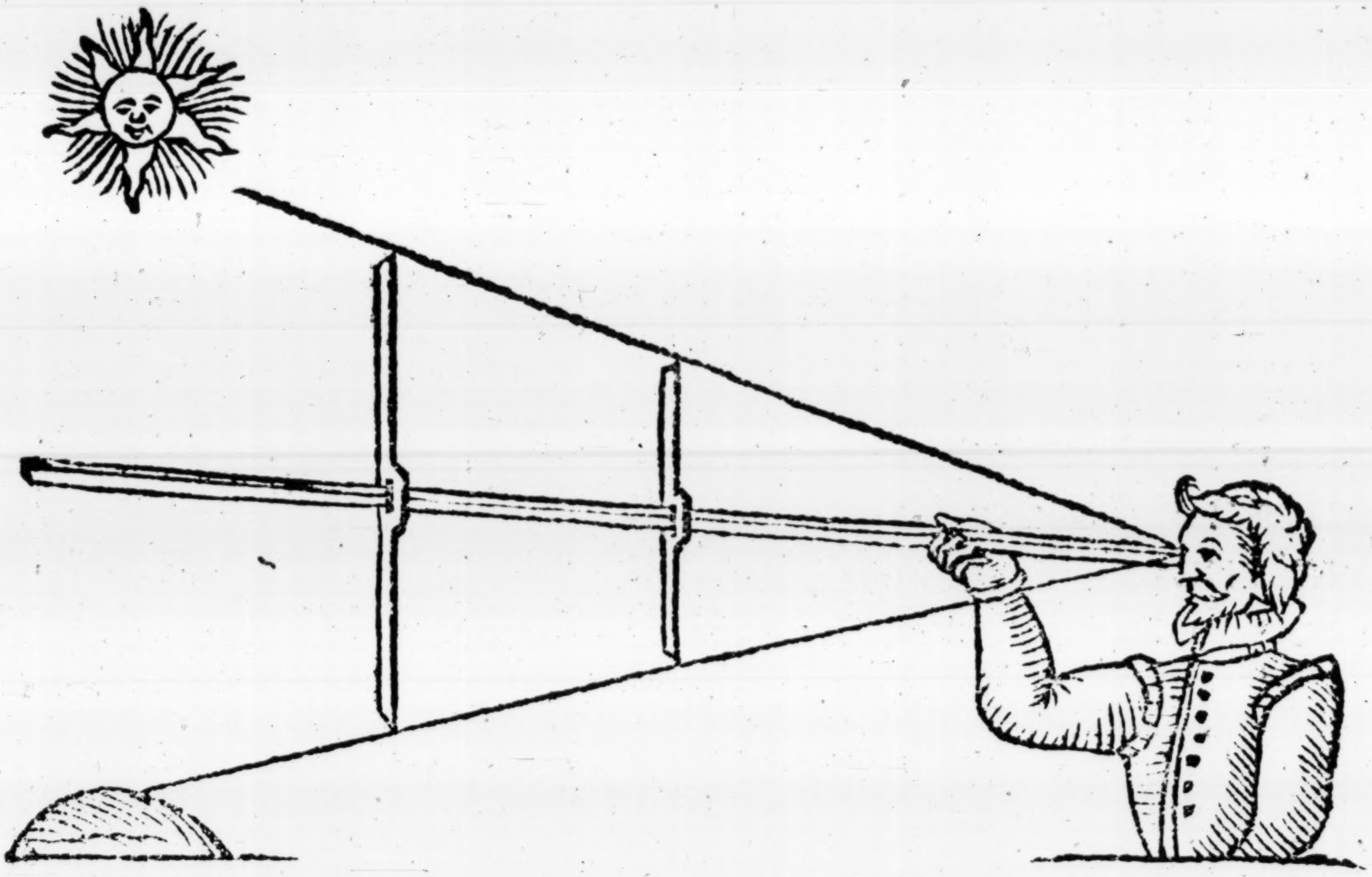
g m
19—60—the Suns diſtance from my zenith.
5—09—the declination.

14—51—the Poles height.

How

How ſhall I know the true order of placing the Croſſe ſtaffe to mine eye, to auoide errour in my obſeruation?

TO finde the true placing of the ſtaffe at your eye thereby to amend the parallax or falſe ſhadowe of your ſight, do thus: take a ſtaffe hauing two croſſes, a long croſſe which endeth in 30. degrees, and a ſhort croſſe which beginneth at 30. deg. where the long croſſe endeth, put the long croſſe vpon his 30. deg. and there make him faſt, then put the ſhort croſſe likewiſe vpon his 30. de. there faſten him without mouing, then ſet the end of your ſtaffe to your eye, mouing it from place to place about your eye, vntill at one inſtant you may ſee the ends of both croſſes, which when you finde, remember that place and the ſtanding of your body, for ſo muſt your ſtaffe be placed, and your body ordered in all your obſeruations.



Are theſe all the rules that appertaine to the finding of the Poles height?

THoſe that trauell farre towards the North vnder whoſe Horizon the Sunne ſetteth not, ſhall ſome time haue occaſion to ſeeke the latitude by the Sunne when the Sunne is North from them, the pole being then betweene the Sunne and their Zenith. When ſuch obſeruations are made, you muſt by your inſtrument ſeeke the Suns height from the Horizon, ſubſtract that height from his declination, and the remaining number ſheweth how far the Equinoctiall is vnder the Horizon vpon the point North, for ſo much is the opoſite parte of the Equator aboue the Horizon vpon the point South, ſubſtract that Meridionall altitude of the Equinoctiall from 90. and the remaining number is the poles height deſired. Example.

The Sunne hauing 22.degrees of North declination, his altitude from the Horizon is obſerued to be 3.degrees 15. minutes, therefore ſubſtracting 3.deg.15.min.from 22.degrees, there reſteth 18.deg.45.min, which is the diſtance of the Equinoctiall from the Horizon, which being taken from 90. there reſteth 71.deg.15.min, the poles eleuation deſired.

g	m	
22	60	the Suns declination.
3	15	the Sunnes altitude.
18	45	the altitude of the equinoctiall.

g	m	
89	60	yͤ diſt. between Zen. & Hori.
18	45	altitude of the Equator.
71	15	the altitude of the pole.

But you muſt know that the declination found in your Regiment, is not the declination which in this caſe you muſt vſe: for the regiment ſheweth the Suns declination vpon the Meridian or South point, in the place for whoſe Meridian the ſame was calculated, and not otherwiſe: therefore it is neceſſary to know the Suns declination at all times, and vpon euery point of the Compaſſe: for I haue beene conſtrained in my Northweſt voyages, being within the frozen zone, to ſearch the latitude by the Sun, at ſuch times as I could ſee the Sun, vpon what point of the Compaſſe ſoeuer, by reaſon of the great fogges and miſtes that thoſe Northern partes are ſubiect vnto: and there is conſideration alſo to be had vpon euery difference of longitude for the Sunnes declination, as I haue by my experience found at my being in the ſtraights of Magilane, where I haue found the ſuns declination to differ from my regiment calculated for London, by ſo much as the Sunne declineth in 5.howers, for ſo much is the difference between the meridian of London, and the Meridian of Cape froward, being in the midſt of the ſaid ſtraights.

How may this declination be found for all times, and vpon all points of the Compaſſe?

First conſider whether the Sun be comming towards the Equinoctiall, or going from him, that being knowne, conſider the time wherin you ſeeke the declination, then looke for the Sunnes declination in your regiment for that day, and alſo looke his declination for the next day, ſubſtract the leſſer out of the greater, and the remainer is the whole declination which the Sun declineth in 24.howers, or in his mouing through all the points of the Compaſſe, ~~for~~ which number you may by the rule of proportion finde his declination vpon euery point of the compas, ~~as~~ or for euery hower of the day, as by theſe examples may appeare. Example. In the yeere 1593. the 20.of March, I deſire to know the Suns declination when he is vpon the North parte of the Meridian of London, I ſeeke the Suns declination for that day, and finde it to be 3.deg.41.min.the Sunn then going from the Equator, I alſo ſearche his declination for the next day being the 21.of March, and finde it to be 4 de. 3.min. I then ſubſtract 3.deg.41.min.from 4.de.3.min.and there reſteth 22 min.

from

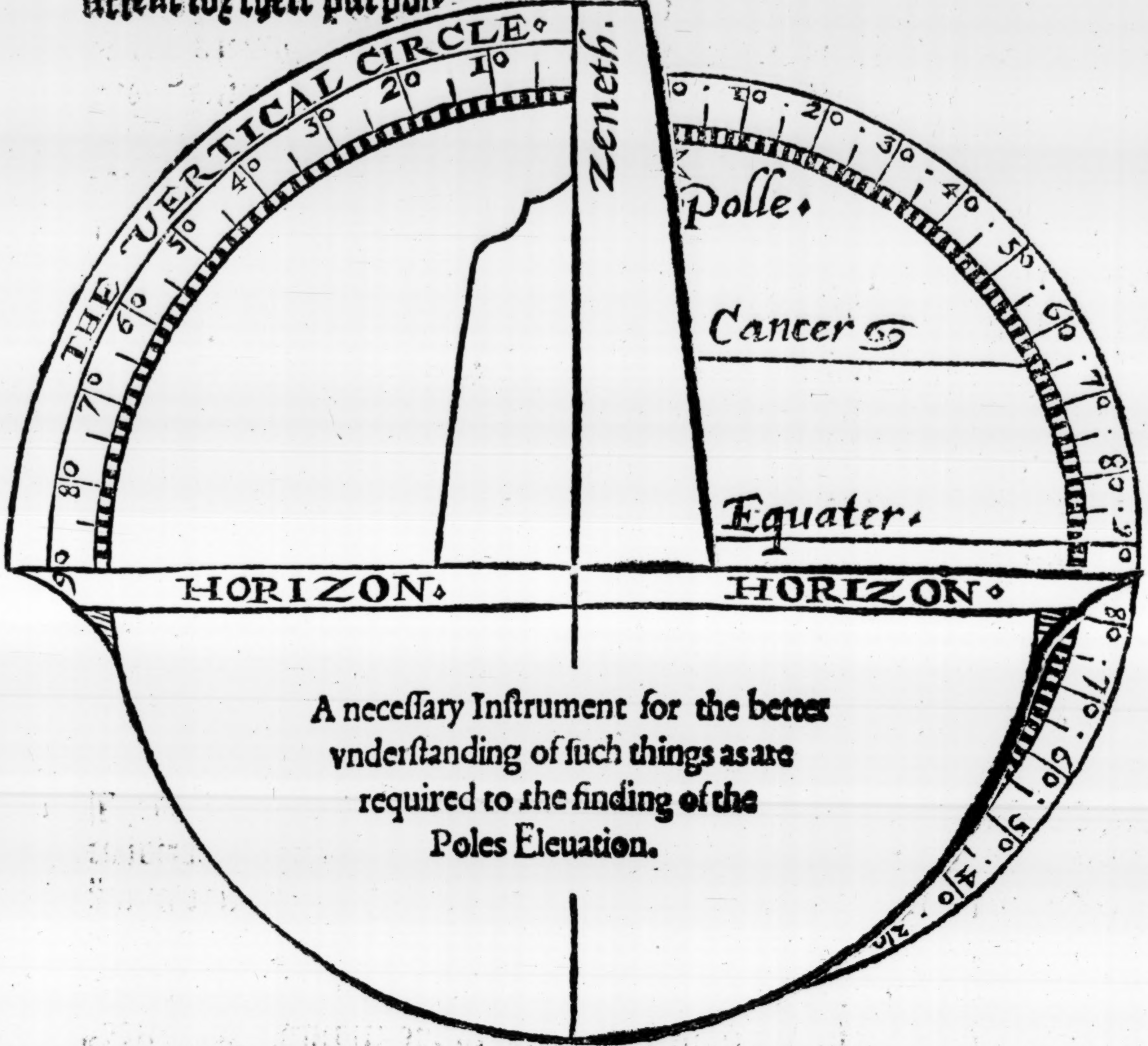
min.ſo much the Sun doth decline in 24.howers, or in going through all the points of the Compaſſe. Then I ſay by the rule of proportion, if 24.howers giue 22.min.of declination, what will 12.howers giue, &c. I multiplye and deuide, and finde it to be 11.min. the Suns declination in 12. howers motion to be added to the declination of the 20.day, being the Suns going from the Equator, or for the points of the Compaſſe I may ſay, if 32.points giue 22.min.of declination, what will 16.pointes giue, which is the diſtance betweene South and North: I multiply and deuide as the rule of proportion requireth, and finde that 16.points giue 11.min.the Suns declination, in mouing through 16, points of the Compaſſe, which is to be added to the declination of the 20.day, becauſe the Sun goeth from the equator, ſo I conclude the declination to be 3.deg: 52.min, the Sun being North the 20, of March.

ho. m. ho.
24——22——12——11
12
44 $\cancel{2}$
22 $\cancel{2}64$
264 $\cancel{2}44$(11
$\cancel{2}4$
$\cancel{2}$

po. m. po. m.
32——22——16——11
16
132 $\cancel{8}$
22 $\cancel{3}5\cancel{2}$
352 $\cancel{3}2\cancel{2}$(11
$\cancel{3}$

Being Weſt from the Meridian of London ~~19~~ 90.degrees of longitude, I deſire to know the Suns declination when the Sun is vpon the Meridian the 20.of March 1593. I muſt here conſider that 90.deg.of longitude make 6.howers of time, for euery hower containeth 15, deg. whereby I know that when the Sun is South at London he is but Eaſt from me, for when it is 12 of the clocke at London, it is but 6. of the clocke in the morning with mee, and when it is 12.of the clocke with me, it is then 6.of the clocke in the after noone at London: therefore I muſt ſeeke for the declination of the Sun at 6.of the clocke in the afternoone, and that is the meridionall declination which I muſt vſe, being 90.deg. Weſt from London, which to doe, the laſt example doth ſufficiently teach you, whereby you may eaſily gather the perfect notice of whatſoeuer is requiſite in any of theſe kinde of obſeruations, if you reade with the eye of reaſon, and labour to vnderſtand with iudgement that which you read.

There is another way moſt excellent for the finding of the Suns declination at all times, that is to ſearch by the Ephimerides the Sunnes true place in the Ecliptick for any time propoſed whatſoeuer, and then by the tables of Sinus the declination is thus knowne. Multiply the Sinus of the Suns longitude from the Equinoctiall points of Aries or Libra, to which ſoeuer he is neereſt, by the Sinus of the Suns greateſt declination, and deuide the product by the whole Sinus, and the arke of the quotient is the declination deſired: but becauſe Seamen are not acquainted with ſuch calculations, I therfore omit to ſpeake further thereof, ſith this plaine way before taught is ſufficient for their purpoſe.



A neceſſary Inſtrument for the better vnderſtanding of ſuch things as are required to the finding of the Poles Eleuation.

The vſe of this Inſtrument.

By this inſtrument you may ſufficiently vnderſtand, the reaſons of whatſoeuer is before ſpoken for the finding of the Poles eleuation, or the latitude of your being: into the conſideration whereof, becauſe the yong practiſer may the better enter, I think it not amiſſe by a few examples to expreſſe the neceſſary vſe thereof.

1. Q. The Sun hauing 7. degrees of North declination, and the pole Artick being 45. degrees aboue the Horizon, I demaund what will be the Sunnes meridionall diſtance from my Zenith?

1. A. First I turne the Horizon vntill I bring the North Pole to be 45. degrees aboue the ſame, there holding the Horizon not to be moued, I then bring the thrid that is faſtened to the Center of the inſtrument, 7. degrees from the Equinoctiall towardes the North, becauſe the Sun hath ſo much North declination, and the thrid doth ſhew me vpon the verticall circle, that the ſunne is 38. degrees from my Zenith.

2.Q. The pole artick being 50 deg. aboue the Horizon, and the Suns diſtance 30.deg. from the Zenith, I demaund what is the Suns declination?

2.A. As in the firſt queſtion I place the North pole 50. degrees aboue the Horizon, there holding the Horizon not to be moued, then I bring the thrid to the 30.degree vpon the verticall circle, becauſe the Sunne is 30. degrees from my Zenith, and then the thrid ſheweth vpon the Meridian betweene the tropick of Cancer and the Equinoctiall, that the Sunne hath 20 degrees of North declination.

3.Q The Sunne hauing 10.deg. of South declination, being vpon the Meridian, is 53.deg. from my Zenith, I demaund what is the poles height?

3.A. In the firſt queſtion the Poles height and the Sunnes declination are giuen, for the finding of the Sunnes meridionall diſtance from the Zenith. In the ſecond the Poles height is giuen, and the Sunnes meridionall diſtance from the Zenith, therby to finde the Sunnes declination. And in this queſtion the Sunnes declination and meridionall diſtance is giuen, for the finding of the Poles height. I therefore bring the thrid faſtned in the center of the inſtrument 10.degrees South from the Equator, between the Equinoctiall and the tropick of Capricorne, there holding the thrid not to be moued, I then turne the Horizon vntill I bring the 53. degree of the verticall circle vnder the thrid, and then the Horizon ſheweth me, that the North pole is 43.degrees aboue the ſame.

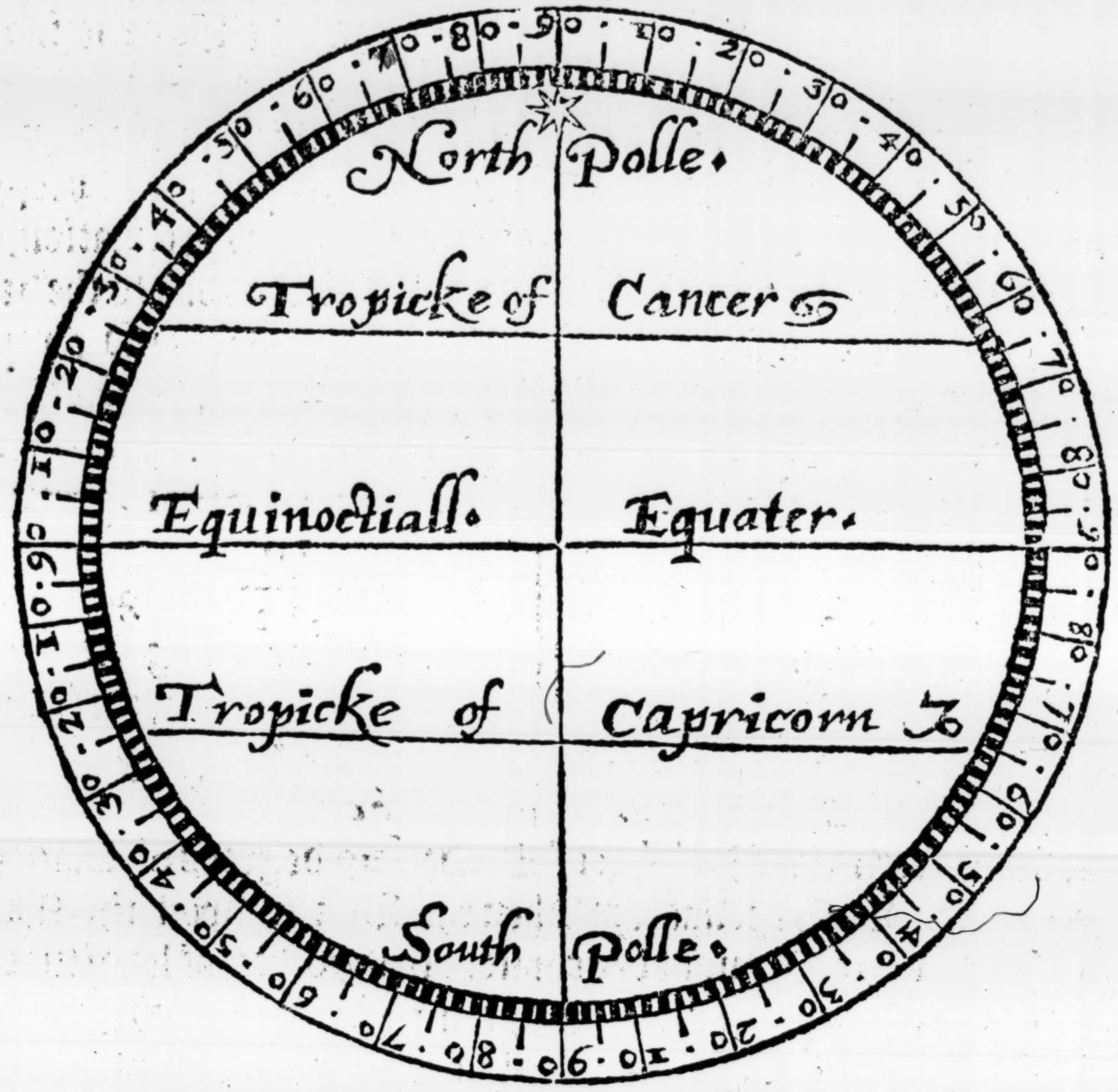
4.Q. The Sun hauing 12.degrees of ſouth declination, and being vpon the Meridian South from me, is 30.degrees aboue the Horizon, I demaund how farre the Sun is from my zenith, how much the Equinoctiall is aboue the Horizon, and what is the Poles height?

4.A. Firſt I bring the thrid to the place of the Sunnes declination as before, there holding it not to be moued, then I turn the Horizon vntill I bring it to be 30 deg. vnder the thrid, and then the thrid ſheweth me that the Sun is 60.deg. from my zenith, and the Horizon ſheweth that the Equinoctiall is 42 deg. aboue the ſame, and that the North pole is alſo eleuated 48. deg. aboue the horizon. Although theſe queſtions are ſo very eaſie and plain, as that they may readily be anſwered by memory, yet becauſe the reaſons how they are anſwered may the better appeare, is the cauſe wherfore they are demaunded and in this ſort anſwered, only for the benefit of ſuch as are not altogether expert in theſe practiſes, that thereby they might likewiſe frame vnto themſelues queſtions of other varietie, and ſo gather thereby the more ſufficient iudgement in this parte of Nauigation.

What is the Zenith?

The Zenith is that prick or point in yͤ heauens which is directly ouer your head, from whence a line falling perpendicularly, will touch the place of your being, and ſo paſſe by yͤ center of the ſphere, and this line may be called the Axis of the Horizon, and the Zenith the Pole of the ſame being 90.deg.

red: but becauſe Seamen are not acquainted with ſuch calculations, I therfore omit to ſpeake further thereof, ſith this plaine way before taught is ſufficient for their purpoſe.



The vſe of this Inſtrument.

BY this inſtrument you may ſufficiently vnderſtand, the reaſons of whatſoeuer is before ſpoken for the finding of the Poles eleuation, or the latitude of your being: into the conſideration whereof, becauſe the yong practiſer may the better enter, I think it not amiſſe by a few examples to expreſſe the neceſſary vſe thereof.

1. Q. The Sun hauing 7. degrees of North declination, and the pole Artick being 45. degrees aboue the Horizon, I demaund what will be the Sunnes meridionall diſtance from my Zenith?

1. A. Firſt I turne the Horizon vntill I bring the North Pole to be 45. degrees aboue the ſame, there holding the Horizon not to be moued, I then bring the thrid that is faſtened to the Center of the inſtrument, 7. degrees from the Equinoctiall towardes the North, becauſe the Sun hath ſo much North declination, and the thrid doth ſhew me vpon the verticall circle, that the ſunne is 38. degrees from my Zenith.

2. Q. The

2. Q. The pole artick being 50 deg. aboue the Horizon, and the Suns diſtance 30. deg. from the Zenith, I demaund what is the Suns declination?

2. A. As in the firſt queſtion I place the North pole 50. degrees aboue the Horizon, there holding the Horizon not to be moued, then I bring the thrid to the 30. degree vpon the verticall circle, becauſe the Sunne is 30. degrees from my Zenith, and then the thrid ſheweth vpon the Meridian betweene the tropick of Cancer and the Equinoctiall, that the Sunne hath 20 degrees of North declination.

3. Q. The Sunne hauing 10. deg. of South declination, being vpon the Meridian, is 53. deg. from my Zenith, I demaund what is the poles height?

3. A. In the firſt queſtion the Poles height and the Sunnes declination are giuen, for the finding of the Sunnes meridionall diſtance from the Zenith. In the ſecond the Poles height is giuen, and the Sunnes meridionall diſtance from the Zenith, therby to finde the Sunnes declination. And in this queſtion the Sunnes declination and meridionall diſtance is giuen, for the finding of the Poles height. I therefore bring the thrid faſtned in the center of the inſtrument 10. degrees South from the Equator, between the Equinoctiall and the tropick of Capricorne, there holding the thrid not to be moued, I then turne the Horizon vntill I bring the 53. degree of the verticall circle vnder the thrid, and then the Horizon ſheweth me, that the North pole is 43. degrees aboue the ſame.

4. Q. The Sun hauing 12. degrees of ſouth declination, and being vpon the Meridian South from me, is 30. degrees aboue the Horizon, I demaund how farre the Sun is from my zenith, how much the Equinoctiall is aboue the Horizon, and what is the Poles height?

4. A. Firſt I bring the thrid to the place of the Sunnes declination as before, there holding it not to be moued, then I turn the Horizon vntill I bring it to be 30 deg. vnder the thrid, and then the thrid ſheweth me that the Sun is 60. deg. from my zenith, and the Horizon ſheweth that the Equinoctiall is 42 deg. aboue the ſame, and that the North pole is alſo eleuated 48. deg. aboue the horizon. Although theſe queſtions are ſo very eaſie and plain, as that they may readily be anſwered by memory, yet becauſe the reaſons how they are anſwered may the better appeare, is the cauſe wherfore they are demaunded and in this ſort anſwered, only for the benefit of ſuch as are not altogether expert in theſe practiſes, that thereby they might likewiſe frame vnto themſelues queſtions of other varietie, and ſo gather thereby the more ſufficient iudgement in this parte of Nauigation.

What is the Zenith?

The Zenith is that prick or point in yͤ heauens which is directly ouer your head, from whence a line falling perpendicularly, will touch the place of your being, and ſo paſſe by yͤ center of the ſphere, and this line may be called the Axis of the Horizon, and the Zenith the Pole of the ſame being 90. deg.

The vſe of the Regiment.

Foraſmuch as the Poles height cannot be obſerued by the Sunne, vnleſſe the Suns true declination be knowne, I haue therfore carefully calculated theſe Tables or Regiment, out of *Stadius* Ephimerides, for the yeeres 1593.94.95. and 1596. which will ſerue vntill the yeere 1612. without further correction: and becauſe there may growe no errour by miſtaking the yeeres, I haue ouer euery moneth written the yeere of the Lord, in which the declination of the ſame month is to be vſed, therefore when in any yeere and moneth you ſeeke the Sunnes declination, firſte looke for the moneth, and there you ſhall finde 4. of thoſe moneths, which are the moneths betweene the Leape yeeres, then look ouer eche of thoſe moneths, vntil you finde the yeere of the Lord wherein you ſeeke the declination, and directly vnder that yere is the month wherin you muſt ſeeke the Suns declination. Example, 1595. the tenth day of February I would know the Suns declination, firſt I ſeeke out February, and ouer the third moneth I ſee the yeere 1595. therefore that is my moneth, againſt the tenth day of which moneth I finde that the ſunne hath 11. degrees 10 minutes of ſouth declination, and after the like manner you muſt doe in all the reſt as occaſion requireth.

Ianuary.

First.			Second.			Third.			Fourth.			
1			2			3			4			
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612			Yeere of the Lord.
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.	
1	21	50	1	21	52	1	22	56	1	21	57	
2	21	40	2	21	43	2	22	9	2	21	48	
3	21	30	3	21	33	3	21	36	3	21	38	
4	21	20	4	21	23	4	21	26	4	21	28	
5	21	9	5	21	16	5	21	15	5	21	17	
6	20	58	6	21	1	6	21	4	6	21	7	
7	20	47	7	20	50	7	20	53	7	20	55	
8	20	35	8	20	38	8	20	41	8	20	44	
9	20	22	9	20	26	9	20	29	9	20	32	
10	20	9	10	20	1[illegible]	10	20	16	10	20	20	
11	19	56	11	20	0	11	20	3	11	20	6	
12	19	43	12	19	47	12	19	50	12	19	53	
13	19	29	13	19	33	13	19	36	13	19	39	
14	19	14	14	19	19	14	19	22	14	19	25	
15	19	0	15	19	4	15	19	8	15	19	11	
16	18	45	16	18	49	16	18	53	16	18	56	
17	18	29	17	18	34	17	18	38	17	18	41	
18	18	14	18	18	19	18	18	22	18	18	26	
19	17	58	19	18	3	19	18	7	19	18	11	
20	17	42	20	17	46	20	17	50	20	17	54	
21	17	25	21	17	30	21	17	34	31	17	38	
22	17	8	22	17	13	22	17	17	22	17	21	
23	16	51	23	16	56	23	17	0	33	17	4	
24	16	32	24	16	38	24	16	43	24	16	47	
25	16	16	25	16	21	25	16	25	25	16	29	
26	15	57	26	16	3	26	16	7	26	16	12	
27	15	39	27	15	45	27	15	49	27	15	54	
28	15	21	28	15	26	28	15	30	28	15	35	
29	15	2	29	15	7	29	15	12	29	15	23	
30	14	43	30	14	48	30	14	53	30	14	58	
31	14	24	31	14	29	31	14	34	31	14	39	

South De

South Declynacon

South De

February.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
1	14	4	1	14	9	1	14	14	1	14	19
2	13	44	2	13	50	2	13	54	2	14	0
3	13	24	3	13	29	3	13	35	3	13	40
4	13	4	4	13	9	4	13	15	4	13	20
5	12	44	5	12	49	5	12	54	5	13	0
6	12	23	6	12	28	6	12	34	6	12	39
7	12	2	7	12	7	7	12	13	7	12	18
8	11	41	8	11	46	8	11	52	8	11	58
9	11	20	9	11	25	9	11	31	9	11	37
10	10	58	10	11	4	10	11	10	10	11	15
11	10	37	11	10	43	11	10	48	11	10	54
12	10	15	12	10	21	12	10	26	12	10	33
13	9	53	13	9	59	13	10	5	13	10	11
14	9	31	14	9	37	14	9	43	14	9	49
15	9	9	15	9	15	15	9	21	15	9	27
16	8	47	16	8	53	16	8	59	16	9	5
17	8	25	17	8	30	17	8	36	17	8	43
18	8	2	18	8	7	18	8	13	18	8	20
19	7	36	19	7	45	19	7	51	19	7	58
20	7	16	20	7	22	20	7	28	20	7	35
21	6	53	21	6	59	21	7	5	21	7	12
22	6	30	22	6	36	22	6	42	22	6	49
23	6	7	23	6	13	23	6	19	23	6	26
24	5	44	24	5	50	24	5	56	24	6	4
25	5	21	25	5	27	25	5	32	25	5	40
26	4	58	26	5	3	26	5	9	26	5	17
27	4	34	27	4	40	27	4	46	27	4	54
28	4	10	28	4	17	28	4	22	28	4	30
									29	4	7

ſouth de

ſouth declynacon

ſouth de

March.

First,			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
1	3	47	1	3	53	1	3	59	1	3	43
2	3	24	2	3	29	2	3	35	2	3	19
3	3	0	3	3	6	3	3	12	3	2	56
4	2	36	4	2	42	4	2	48	4	2	32
5	2	13	5	2	18	5	2	25	5	2	9
6	1	49	6	1	55	6	2	1	6	1	45
7	1	25	7	1	31	7	1	37	7	1	22
8	1	2	8	1	11	8	1	14	8	0	59
9	0	39	9	0	47	9	0	50	9	0	34
10	0	15	10	0	0	10	0	26	10	0	11
11	0	8	11	0	3	11	0	3	11	0	12
12	0	32	12	0	27	12	0	21	12	0	36
13	0	56	13	0	51	13	0	44	13	0	59
14	1	19	14	1	14	14	1	8	14	1	23
15	1	43	15	1	37	15	1	31	15	1	46
16	2	6	16	2	1	16	1	55	16	2	10
17	2	30	17	2	24	17	2	18	17	2	33
18	2	54	18	2	48	18	2	41	18	2	56
19	3	17	19	3	11	19	3	5	19	3	20
20	3	41	20	3	34	20	3	28	20	3	43
21	4	3	21	3	57	21	3	[illegible]	21	4	6
22	4	27	22	4	21	22	4	15	22	4	29
23	4	50	23	4	44	23	4	38	23	4	52
24	5	13	24	5	7	24	5	1	24	5	15
25	5	36	25	5	30	25	5	24	25	5	38
26	5	59	26	5	52	26	5	47	26	6	1
27	6	21	27	6	15	27	6	10	27	6	23
28	6	44	28	6	38	28	6	32	28	6	46
29	7	6	29	7	1	29	6	55	29	7	8
30	7	29	30	7	23	30	7	18	30	7	30
31	7	51	31	7	46	31	7	40	31	7	52

south de

south declynacon

south de

Equi

noctia

l

north de.

north declynacon

north de

Aprill.

First,			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G.	M.	D.	G.	M.	D.	G.	M.	D,	G	M.
1	8	13	1	8	8	1	8	10	1	8	15
2	8	35	2	8	30	2	8	25	2	8	37
3	8	57	3	8	52	3	8	47	3	8	58
4	9	19	4	9	14	4	9	9	4	9	19
5	9	41	5	9	36	5	9	30	5	9	41
6	10	2	6	9	57	6	9	52	6	10	2
7	10	23	7	10	18	7	10	13	7	10	23
8	10	44	8	10	40	8	10	34	8	10	44
9	11	5	9	11	1	9	10	55	9	11	5
10	11	25	10	11	21	10	11	16	10	11	25
11	11	45	11	11	42	11	11	36	11	11	46
12	12	6	12	12	2	12	11	56	12	12	6
13	12	26	13	12	22	13	12	16	13	12	26
14	12	46	14	12	45	14	12	36	14	12	46
15	13	6	15	13	3	15	12	56	15	13	5
16	13	25	16	13	23	16	13	16	16	13	25
17	13	44	17	13	42	17	13	35	17	13	44
18	14	4	18	14	1	18	13	55	18	14	3
19	14	22	19	14	20	19	14	14	19	14	22
20	14	41	20	14	38	20	14	32	20	14	40
21	14	59	21	14	58	21	14	51	21	14	59
22	15	17	22	15	15	22	15	9	22	15	17
23	15	35	23	15	33	23	15	27	23	15	35
24	15	53	24	15	50	24	15	45	24	15	52
25	16	10	25	16	8	25	16	2	25	16	9
26	16	27	26	16	25	26	16	19	26	16	27
27	16	44	27	16	43	27	16	36	27	16	43
28	17	1	28	16	58	28	16	53	28	17	0
29	17	17	29	17	14	29	17	9	29	17	16
30	17	33	30	17	30	30	17	26	30	17	32

north de.

north declination

north de.

May.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
1	17	49	1	17	45	1	17	41	1	17	48
2	17	57	2	18	1	2	17	57	2	18	3
3	18	12	3	18	16	3	18	12	3	18	18
4	18	27	4	18	31	4	18	27	4	18	33
5	18	41	5	18	45	5	18	45	5	18	48
6	18	56	6	19	0	6	18	56	6	19	2
7	19	9	7	19	13	7	19	10	7	19	16
8	19	23	8	19	27	8	19	23	8	19	29
9	19	36	9	19	40	9	19	38	9	19	42
10	19	49	10	19	53	10	19	50	10	19	56
11	20	2	11	20	6	11	20	3	11	20	8
12	20	14	12	20	17	12	20	15	12	20	20
13	20	26	13	20	30	13	20	27	13	20	32
14	20	38	14	20	41	14	20	39	14	20	43
15	20	49	15	20	53	15	20	50	15	20	54
16	21	0	16	21	4	16	21	1	16	21	5
17	21	10	17	21	14	16	21	11	17	21	16
18	21	20	18	21	24	18	21	22	18	21	26
19	21	30	19	21	34	19	21	2	19	21	35
20	21	39	20	21	43	20	21	41	20	21	45
21	21	49	21	21	52	21	21	50	21	21	54
22	21	57	22	22	0	22	21	59	22	22	2
23	22	6	23	22	8	23	22	7	23	22	10
24	22	14	24	22	16	24	22	15	24	22	18
25	22	21	25	22	24	25	22	22	25	22	25
26	22	2[illegible]	26	22	31	26	22	[illegible]0	26	22	33
27	22	35	27	22	37	27	22	[illegible]	27	22	[illegible]9
28	22	41	28	22	43	28	22	[illegible]2	28	22	4[illegible]
29	22	4[illegible]	29	22	49	29	22	[illegible]8	29	22	51
30	22	52	30	22	54	30	22	5[illegible]	30	22	56
31	22	57	31	23	0	31	22	[illegible]	31	23	1

north de

north declynacon

north de

Iune.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
1	23	4	1	23	4	1	23	3	1	23	6
2	23	9	2	23	8	2	23	7	2	23	10
3	23	13	3	23	12	3	23	11	3	23	13
4	23	16	4	23	16	4	23	15	4	23	17
5	23	19	5	23	19	5	23	18	5	23	20
6	23	22	6	23	21	6	23	21	6	23	22
7	23	24	7	23	23	7	23	23	7	23	24
8	23	26	8	23	25	8	23	25	8	23	26
9	23	27	9	23	26	9	23	26	9	23	27
10	23	28	10	23	27	10	23	27	10	23	28
11	23	28	11	23	28	11	23	28	11	23	28
12	23	28	12	23	28	12	23	28	12	23	28
13	23	28	13	23	28	13	23	28	13	23	23
14	23	27	14	23	27	14	23	27	14	23	26
15	23	26	15	23	26	15	23	26	15	23	25
16	23	24	16	23	25	16	23	25	16	23	23
17	23	22	17	23	23	17	23	23	17	23	21
18	23	19	18	23	20	18	23	21	18	23	18
19	23	16	19	23	17	19	23	18	19	23	15
20	23	13	20	23	14	20	23	15	20	23	12
21	23	9	21	23	10	21	23	11	21	23	8
22	23	5	22	23	6	22	23	7	22	23	4
23	23	1	23	23	2	23	23	4	23	22	59
24	22	56	24	22	57	24	22	58	24	22	54
25	22	51	25	22	52	25	22	53	25	22	49
26	22	45	26	22	46	26	22	48	26	22	43
27	22	38	27	22	40	27	22	41	27	22	39
28	22	32	28	22	34	28	22	35	28	22	30
29	22	25	29	22	27	29	22	26	29	22	23
30	22	18	30	22	20	30	22	21	30	22	15

north d

north declynacon

north d

Iuly.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M
1	22	10	1	22	12	1	22	21	1	22	12
2	22	2	2	22	4	2	22	6	2	22	4
3	21	54	3	21	56	3	21	58	3	21	56
4	21	45	4	21	47	4	21	49	4	21	47
5	21	35	5	21	38	5	21	40	5	21	38
6	21	26	6	21	28	6	21	30	6	21	28
7	21	16	7	21	19	7	21	21	7	21	19
8	21	6	8	21	6	8	21	11	8	21	2
9	20	55	9	20	58	9	21	0	9	20	52
10	20	44	10	20	47	10	20	49	10	20	40
11	20	33	11	20	36	11	20	38	11	20	29
12	20	21	12	20	24	12	20	26	12	20	17
13	20	9	13	20	12	13	20	14	23	20	5
14	19	57	14	20	0	14	20	6	14	19	52
15	19	44	15	19	47	15	19	49	15	19	4
16	19	31	16	19	34	16	19	36	16	19	27
17	19	17	17	19	20	17	19	23	17	19	13
18	19	4	18	19	7	18	19	10	18	18	59
19	18	42	19	18	53	19	18	56	19	18	45
20	18	35	20	18	38	20	18	43	20	18	31
21	18	21	21	18	24	21	18	28	21	18	16
22	18	6	22	18	9	22	18	13	22	18	1
23	17	51	23	17	54	23	17	58	23	17	47
24	17	35	24	17	38	24	17	42	24	17	30
25	17	19	25	17	23	25	17	26	25	17	14
26	17	3	26	17	6	26	17	11	26	16	58
27	16	47	27	16	50	27	16	55	27	16	42
28	16	30	28	16	33	28	16	38	28	16	25
29	16	13	29	16	17	29	16	21	29	16	8
30	15	56	30	16	0	30	16	4	30	15	51
31	15	39	31	15	42	31	15	47	31	15	33

north de

north declynacon

north de

August.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G.	M.	D	G.	M.	D.	G.	M.	D.	G.	M.
1	15	21	1	15	25	1	15	30	1	15	15
2	15	3	2	15	7	2	15	12	2	14	57
3	14	45	3	14	49	3	14	54	3	14	39
4	14	27	4	14	31	4	14	36	4	14	20
5	14	8	5	14	12	5	14	13	5	14	2
6	13	49	6	13	53	6	13	59	6	13	43
7	13	30	7	13	34	7	13	40	7	13	24
8	13	9	8	13	15	8	13	2	8	13	5
9	12	51	9	12	56	9	13	2	9	12	45
10	12	31	10	12	36	10	12	42	10	12	25
11	12	12	11	12	16	11	12	23	11	12	5
12	11	52	12	11	56	12	12	3	12	11	41
13	11	32	13	11	36	13	11	42	13	11	25
14	11	11	14	11	16	14	11	22	14	11	4
15	10	51	15	10	59	15	11	2	15	10	44
16	10	30	16	10	35	16	10	41	16	10	23
17	10	9	17	10	14	17	10	20	17	10	2
18	9	48	18	9	53	18	9	59	18	9	41
19	9	27	19	9	31	19	9	39	19	9	19
20	9	5	20	9	10	20	9	16	20	8	58
21	8	44	21	8	49	21	8	55	21	8	35
22	8	22	22	8	27	22	8	33	22	8	15
23	8	0	23	8	5	23	8	11	23	7	53
24	7	38	24	7	43	24	7	50	24	7	31
25	7	16	25	7	21	25	7	28	25	7	9
26	6	53	26	6	59	26	7	5	26	6	47
27	6	31	27	6	36	27	6	43	27	6	25
28	6	9	28	6	14	28	6	20	28	6	1
29	5	46	29	5	51	29	5	57	29	5	39
30	5	23	30	5	29	30	5	31	30	5	16
31	5	0	31	5	6	31	5	12	31	4	53

north De.

north declynacion

north De.

September.

First,			Second.			Third.			Fourth.		
1			2			3			4		
1593 1597 1601 1605 1609			1594 1598 1602 1606 1610			1595 1599 1603 1607 1611			1596 1600 1604 1608 1612		
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
1	4	38	1	4	42	1	4	49	1	4	43
2	4	14	2	4	20	2	4	26	2	4	20
3	3	51	3	3	56	3	4	3	3	3	57
4	3	28	4	3	33	4	3	39	4	3	34
5	3	5	5	3	10	5	3	16	5	3	12
6	2	37	6	2	47	6	2	53	6	2	47
7	2	18	7	2	23	7	2	29	7	2	24
8	1	55	8	2	0	8	2	6	8	2	1
9	1	31	9	1	37	9	1	43	9	1	37
10	1	8	10	1	13	10	1	19	10	1	14
11	0	45	11	0	49	11	0	56	11	0	51
12	0	21	12	0	26	12	0	32	12	0	27
13	0	2	13	0	3	13	0	9	13	0	3
14	0	25	14	0	21	14	0	15	14	0	20
15	0	48	15	0	44	15	0	38	15	0	43
16	1	12	16	1	8	16	1	2	16	1	7
17	1	35	17	1	31	17	1	25	17	1	30
18	1	58	18	1	55	18	1	48	18	1	54
19	2	22	19	2	18	19	2	12	19	2	17
20	2	45	20	2	45	20	2	35	20	2	41
21	3	9	21	3	5	21	[illegible]	59	21	3	4
22	3	32	22	3	28	22	3	22	22	3	27
23	3	55	23	3	51	23	3	45	23	3	50
24	4	18	24	4	15	24	4	9	24	4	14
25	4	41	25	4	38	25	4	32	25	4	37
26	5	4	26	5	1	26	4	55	26	5	0
27	5	27	27	5	23	27	5	18	27	5	23
28	5	51	28	5	46	28	5	41	28	5	46
29	6	14	29	6	9	29	6	4	29	6	8
30	6	36	30	6	32	30	6	26	30	6	31

north de

north declynacon

north de

Equi nocti all

south de

south declinacion

south de

October.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593			1594			1595			1596		
1597			1598			1599			1600		
1601			1602			1603			1604		
1605			1606			1607			1603		
1609			1610			1611			1612		
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
1	7	0	1	6	54	1	6	48	1	6	53
2	7	22	2	7	17	2	7	11	2	7	16
3	7	44	3	7	39	3	7	33	3	7	38
4	8	7	4	8	1	4	7	55	4	8	1
5	8	29	5	8	24	5	8	18	5	8	23
6	8	51	6	8	46	6	8	40	6	8	45
7	9	13	7	9	8	7	9	2	7	9	7
8	9	36	8	9	30	8	9	24	8	9	30
9	9	58	9	9	52	9	9	42	9	9	52
10	10	19	10	10	13	10	10	8	10	10	13
11	10	41	11	10	35	11	10	29	11	10	35
12	11	2	12	11	0	12	10	51	12	10	56
13	11	23	13	11	18	13	11	12	13	11	17
14	11	45	14	11	39	14	11	33	14	11	39
15	12	5	15	12	0	15	11	54	15	11	59
16	12	26	16	12	21	16	12	15	16	12	20
17	12	47	17	12	41	17	12	36	17	12	41
18	13	7	18	13	1	18	12	56	18	13	1
19	13	27	19	13	22	19	13	17	19	13	21
20	13	47	20	13	41	20	13	36	20	13	41
21	14	6	21	14	1	21	13	56	21	14	1
22	14	26	22	14	21	22	14	16	22	14	17
23	14	45	23	14	40	23	14	35	23	14	39
24	15	4	24	14	59	24	14	54	24	14	58
25	15	23	25	15	17	25	15	13	25	15	17
26	15	41	26	15	36	26	15	31	26	15	35
27	15	59	27	15	54	27	15	50	27	15	54
28	16	17	28	16	12	28	16	8	28	16	12
29	16	35	29	16	30	29	16	25	29	16	29
30	16	52	30	16	47	30	16	43	30	16	47
31	17	9	31	17	4	31	17	0	31	17	4

South dec.

South declynacion

South dec

Nouember.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593			1594			1595			1596		
1597			1598			1599			1600		
1601			1602			1603			1604		
1605			1606			1607			1608		
1609			1610			1611			1612		
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M
1	17	26	1	17	21	1	17	17	1	17	36
2	17	42	2	17	38	2	17	33	2	17	53
3	17	58	3	17	54	3	17	49	3	18	9
4	18	14	4	18	9	4	18	6	4	18	25
5	18	29	5	18	25	5	18	22	5	18	41
6	18	44	6	18	40	6	18	37	6	18	55
7	18	59	7	18	55	7	18	52	7	19	10
8	19	14	8	19	10	8	19	6	8	19	24
9	19	26	9	19	24	9	19	21	9	19	38
10	19	42	10	19	36	10	19	35	10	19	52
11	19	45	11	19	52	11	19	48	11	20	5
12	20	8	12	20	5	12	20	7	12	20	18
13	20	21	13	20	18	13	20	14	13	20	30
14	20	34	14	20	30	14	20	27	14	20	43
15	20	46	15	20	42	15	20	39	15	20	54
16	20	57	16	20	54	16	20	51	16	21	6
17	21	8	17	21	5	17	21	3	17	21	17
18	21	19	18	21	16	18	21	14	18	21	27
19	21	29	19	21	27	19	21	24	19	21	37
20	21	39	20	21	37	20	21	35	20	21	47
21	21	49	21	21	47	21	21	44	31	21	56
22	21	58	22	21	56	22	21	54	22	22	5
23	22	7	23	22	5	23	22	3	23	22	14
24	22	15	24	22	21	24	22	11	24	22	21
25	22	23	25	22	14	25	22	19	25	22	29
26	22	31	26	22	29	26	22	27	26	22	36
27	22	38	27	22	37	27	22	34	27	22	43
28	22	44	28	22	43	28	22	41	28	22	49
29	22	50	29	22	49	29	22	47	29	22	55
30	22	56	30	22	54	30	22	53	30	23	0

South de.

South declynacion

South de.

December.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593			1594			1595			1596		
1597			1598			1599			1600		
1601			1602			1603			1604		
1605			1606			1607			1608		
1609			1610			1611			1612		
D.	G	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
1	23	1	1	23	0	1	22	58	1	23	5
2	23	6	2	23	5	2	23	4	2	23	10
3	23	10	3	23	9	3	23	8	3	23	14
4	23	14	4	23	13	4	23	12	4	23	17
5	23	17	5	23	17	5	23	16	5	23	20
6	23	20	6	23	20	6	23	9	6	23	22
7	23	23	7	23	22	7	23	22	7	23	25
8	23	25	8	23	25	8	23	24	8	23	26
9	23	26	9	23	26	9	23	26	9	23	27
10	23	27	10	23	27	10	23	27	10	23	28
11	23	28	11	23	28	11	23	28	11	23	28
12	23	28	12	23	28	12	23	28	12	23	28
13	23	28	13	23	28	13	23	28	13	23	27
14	23	27	14	23	27	14	23	27	14	23	26
15	23	26	15	23	26	15	23	26	15	23	24
16	23	24	16	23	24	16	23	25	16	23	21
17	23	21	17	23	22	17	23	23	17	23	18
18	23	19	18	23	20	18	23	20	18	23	15
19	23	16	19	23	17	19	23	17	19	23	12
20	23	12	20	23	13	20	23	14	20	23	8
21	23	8	21	23	7	21	23	10	21	23	6
22	23	3	22	23	4	22	23	5	22	22	57
23	22	58	23	22	59	23	23	1	23	22	52
24	22	52	24	22	54	24	22	56	24	22	46
25	22	47	25	22	48	25	22	50	25	22	40
26	22	40	26	22	42	26	22	43	26	22	33
27	22	36	27	22	35	27	22	37	27	22	25
28	22	30	28	22	28	28	22	30	28	22	18
29	22	22	29	22	20	29	22	22	29	22	9
30	22	14	30	22	12	30	22	14	30	22	0
31	22	6	31	22	4	31	22	6	31	21	52

South [illegible].

South [illegible]

outh [illegible]

The Seamans Secrets.

What is the Sea Chart?

The Sea Chart is a ſpeciall inſtrument for the Seamans vſe, whereby the hidrographicall deſcription of the Occean Seas, with the anſwerable geopraphicall limits of the earth, are ſuppoſed to be in ſuch ſort giuen, as that the longitudes and latitudes of all places, with the true diſtance and courſe betweene place and place might thereby be truely knowne. But becauſe there is no proportionable agreement betweene a Globus ſuperficies and a plaine ſuperficies, therefore a Chart doth not expreſſe that certaintie of the premiſſes which is thereby pretended to be giuen, for things are beſt deſcribed vpon bodies agreeable to their owne forme. And whereas in the true nature of the Sphere there can be no perallelles deſcribed but the Eaſt and Weſt courſes onely, the reſt of the courſes being concurued lines, aſcendent toward the Poles, the Meridians all concurring and ioyning together in the Poles, notwithſtanding in the Sea Chart all thoſe courſes are deſcribed as perallells, without any diuerſitie, alteration, or diſtinction to the contrary, whereby the inſtrument is apparantly faultie: yet it cannot be denyed but Charts for ſhort courſes are to very good purpoſe for the Pilots vſe, and in long courſes, be the diſtance neuer ſo farre, if the Pilote returne by the ſame courſe, whereby in the firſt he proſecuted his voyage, his Chart will be without errour, as an inſtrument of very great commoditie: but if he returne by any other way, then by that which hee went forth, the imperfections of the Chart will then appeare to be very great, eſpecially if the voyage be long, or that the ſame be in the North partes of the worlde, the farther towards the North, the more imperfect: therefore there is no inſtrument anſwerable to the Globe or peradoxall Chart, for all courſes and climats whatſoeuer, by whom all deſired truth is moſt plentifully manifeſted, as ſhall hereafter at large be declared: but for the coſting of any ſhore or countrie, or for ſhorte voyages, there is no inſtrument more conuenient for the Seamans vſe, then the well deſcribed Sea Chart.

What is the vſe of the sea Chart?

By the directions of the ſea chart, the ſkilful Pilote conuaieth his ſhip from place to place, by ſuch courſes as by the chart are made known vnto him, together with the helpe of his Compaſſe or Croſſe ſtaffe as before is ſhewed, for the Croſſe ſtaffe, the Compaſſe and Chart, are ſo neceſſarily ioyned together, as that the one may not well be without the other, in the execution of the practiſes of Nauigation: for as the Chart ſheweth the courſes, ſo doth the Compaſſe direct the ſame, and the Croſſe ſtaffe by euery perticular obſerued latitude doth confirme the truth of ſuch courſes, and alſo giueth the certaine diſtance that the Ship hath ſayled vpon the ſame.

And in the vſe or vnderſtanding of the Sea Chart there are fiue thinges cheefely to be regarded.

The firſt is, that the Countries or geographie of the Chart be knowne, with euery Cape, Promontery, Port, Hauen, Bay, Sands, Rocks, and dangers therein contained.

Secondly, that the lines drawne vpon the Chart, with their ſeuerall properties be likewiſe vnderſtoode.

Thirdly, that the latitudes of ſuch places as are within the Chart be alſo knowne, as by the Chart they are expreſſed.

Fourthly, that you be able to meaſure the diſtances betweene place and place vpon the Chart.

And fiftly, the Seaman muſt be able by his Chart to know the true courſes betweene any Iles, contenents, or Capes whatſoeuer, for by theſe fiue diuerſities, the Chart is to be vſed in the ſkill of Nauigation.

How is the latitude of places knowne by the Chart?

The latitude is thus found by the Chart, vpon the place whoſe latitude you deſire to know, ſet one foot of your compaſſes, then ſtretch the other foote to the next Eaſt and Weſt line (for that line is your director) keeping that foote ſtill vpon the ſame line, moue your hand and Compaſſes Eaſt or Weſt as occaſion requireth, vntill you bring the Compaſſes to the graduated Meridian, and there that foote of the Compaſſes which ſtoode vpon the place whoſe latitude you would know, dooth ſhewe the latitude of the ſame place.

How is the courſe betweene place and place knowne?

When there are two places aſſigned, the courſe betweene which you deſire to know, ſet one foote of your Compaſſes vpon one of the places, then by diſcretion conſider the lines that lead toward the other place, ſtretching the other foote of the Compaſſes to one of thoſe lines, and to that part of the line which is neereſt to you, keeping that foote ſtill vpon the ſame line, moue your hand and Compaſſes toward the other place, and ſee whether the other foot of the Compaſſes that ſtood vpon the firſt place, doe by this direction touch the ſecond place, which if it doe, then that line whereupon you kept the one foote of your Compaſſes, is the courſe betweene thoſe places: but if it touch not the place, you muſt by diſcretion ſearch vntill you finde a line, wherupon keeping the one foote of the Compaſſes, will lead the other foote directly from the one place to the other, for that is the courſe betweene thoſe two places.

How is the diſtance of places found vpon the Chart?

IF the places be not farre aſunder, ſtretch a paire of Compaſſes betweene them, ſetting the one foote of the compaſſes vpon one of the places, and the other vpon the other place, then not altering the compaſſes, ſet them vpon the graduated Meridian of your Chart, and allowing 20. leags for euery degree that is contained betweene the 2. feet of your Compaſſes, the diſtance deſired is therby knowne: if betweene the places there be 5. degrees, then they are 100. leages aſunder, &c. But if the diſtance betweene the places be ſo great, as that the compaſſes cannot reach betweene them, then take out 5. degrees with your compaſſes which is 100. leages, and therewith you may meaſure the diſtance as practiſe will teach you. There is alſo in euery Chart a ſcale of leages laide downe, whereby you may meaſure diſtances, as commonly is vſed.

How doth the Pilote order theſe matters, thereby to conduct his Ship from place to place?

THe Pilote in the execution of this parte of Nauigation, doth with carefull regarde conſider three eſpeciall thinges, whereupon the full practiſes are grounded.

1 Of which the firſt is, the good obſeruation of his latitude which how it may be knowne is before ſufficiently expreſſed.

2 The ſecond is a carefull regarde vnto his ſteredge, with very diligent examination of the truth of his Compaſſe, that it be without variation or other impediments.

3 And the third is a carefull conſideration of the number of leags that the Ship ſaileth in euery houre or watch, to the neereſt eſtimation that poſſibly he can giue, for any two of theſe three practiſes being truely giuen, the third is therby likewiſe knowne.

As by the Corſe and height the diſtance is manifeſted, by the diſtance and Corſe the height is knowne: by the height and diſtance the Corſe is giuen, of which 3. thinges the Pilote hath onely his height in certaintie: the corſe is ſomewhat doubtfull, and the diſtance is but barely ſuppoſed, notwithſtanding from his altitude and corſe he concludeth the truth of his practiſe, proceeding in this ſort.

Firſt he conſidereth in what latitude the place ſtandeth from whence hee ſhapeth his Corſe, which for an example ſhalbe the Lyzart ſtanding in 50. degrees of ſeptentrionall latitude, then directing his corſe S.W. ſaileth 3. or 4. daies or longer in ſuch thick weather, as that he is not able to make any obſeruation of the Poles altitude, in which time he omitteth not to keepe an accompt how many leages the ſhip hath ſailed vpon that corſe as neere as he can geſſe, which number of leages in this example ſhalbe 100. according to his iuugement: then hauing conuenient weather, he obſerueth in what latitude he is, and findeth himſelfe to be in 47. degrees, now with his compaſſes he taketh the diſtance of 100. leages, which is the quantitie of the Ships runne by his ſuppoſition, and then ſetting one foote of the compaſſes vpon the Lizart, which is the place from whence hee began his corſe, and directly S.W. from the ſame he ſetteth the other point of the compaſſes, by the direction of another paire of compaſſes, in ſuch ſorte as corſes are found, and there he maketh a prick for the place of his ſhips being, according to his reconing and Corſe.

And now ſearching whether it doe agree with his height, (for the height, corſe, and diſtance, muſt all agree together) he findeth that his prick ſtandeth in 46. degrees, 29. minutes, but it ſhould ſtand in 47. degrees, to agree with his obſeruation. Therefore perceiuing that he hath giuen the ſhip too much way, he bringeth his corſe and obſerued altitude to agree, and then hee ſeeth that his ſhip hath ſailed but 85. leages, and there he layeth downe a prick for the true place of his ſhips being, according to his corſe and latitude, for ſo by his corſe and height he findeth the truth of his diſtance, and reproueth his ſuppoſed accompt to be 15. leags too much: and after this ſort he proceedeth from place to place, vntill he ariue vnto his deſired porte: which is a concluſion infallible if there be no other impediments, (whereof there hath not been good conſideration had) which may breede errour, for from ſuch negligence there may ariſe many inconueniences.

What may thoſe impediments be?

BY experience at the Sea we finde many impediments that ſo diſturb the expected concluſion of our practiſes, as that they agree not with the true poſitions of arte. For, firſt it is a matter not common to haue the winde ſo beneficiall, as that a ſhip may ſaile thereby, betweene any two aſſigned places vpon the direct corſe, but that by the contrarietie of windes, ſhe may be conſtrained to trauers vpon all the points of the Compaſſe, (the nature whereof I haue before ſufficiently expreſſed.

Secondly, although the winde may in ſome ſorte fauour, yet the ſhip may haue ſuch a leward condicion, as that ſhe may make her way 2. or 3. pointes from her caping.

Thirdly, the ſteredge may be ſo diſorderly handled, as that thereby the

Pylote may be abuſed.

And laſtly, the compaſſe may be ſo varied, as that the Pylote may likewiſe thereby be drawne into errour, of all which things and many moe, as the nature of his ſayling, whether before the winde, quartering, or by a bowling, or whether with lofty or low ſailes, with the benefites or hinderances of the ſea, tydegates, ſtreames, and forced ſet thereof, &c. Of all which thinges I ſay, the ſkilfull Pylote muſt haue carefull conſideration, which are better learned by practiſe then taught by penne: for it is not poſſible that any man can be a good and ſufficient pylote or ſkilful Seaman, but by painefull & diligent practiſe, with the aſſiſtance of arte, wherby the famous Pylote may be eſteemed worthy of his profeſſion, as a member meete for the common weale.

And now hauing ſufficiently ſhewed you the ordering of your Chart for the execution of the ſkill of Nauigation, and being alſo deſirous that you ſhould effectually vnderſtand the full nature and vſe of the ſame. I thinke it good by a few queſtions to giue you an occaſion to exerciſe your ſelfe in the perfect accompliſhment of ſuch concluſions as are by this excellent and commodious inſtrument to be perfourmed.

Neceſſary queſtions for the better vnderſtanding of the commodious vſe of the Chart.

1 Q. If I ſayle 70. leages vpon the Southweſt corſe, I demaund how many degrees I ſhall lay or depreſſe the Pole?

A. The difference of the latitude wilbe 2. degrees, 30. minutes.

2 Q. If in ſayling Weſt Norweſt I raiſe the Pole 3. degrees, 30. minutes, I demaund how many leages I haue ſailed?

A. The diſtance ſailed, is 180. leages.

3 Q. If in ſayling 108. leages between Weſt and Nor, I raiſe the Pole 3. degrees, I demaund vpon what corſe I haue ſailed, and how farre I am from the Meridian from whence I began that corſe?

A. The corſe ſailed is N. w. b. W. and the diſtance from the Meridian is 90. leages.

4 Q. If in ſayling 154. leages I be 80. leages Weſt from the Meridian from whence I began my corſe, I demaund vpon what point of the compaſſe I haue ſailed, and how much I haue raiſed the Pole?

A. The corſe is N w, b. N. and the Pole is raiſed 6. degrees.

5 Q. If I ſayle N w. vntill I be 50. leags from the Meridian where I began my Corſe, I demaund how many leages I haue ſailed, and how much the Pole is raiſed?

A. The diſtance ſailed is 71. leages, and the Pole is raiſed 2. degrees, 30. minutes.

6 Q. If in ſayling W.N.W. I doe in 30. howers raiſe 2. degrees, how many degrees ſhould I haue raiſed the Pole, if the ſame motion had beene North and by Weſt?

A. You ſhould haue raiſed 5. degrees.

7 Q. A Ship ſailing towards the Weſt, for euery 80. leages that ſhe ſayleth in her Corſe, ſhe departeth from the Meridian from whence ſhe began the ſame Corſe 45. leags, I demaund vpon what point of the Compaſſe, and how many leages ſhe hath ſailed, in rayſing the Pole 5. degrees?

A. She hath ſailed Northweſt by North 120. leages.

8 Q. A Pylote ſayling toward the Weſt 100. leages, hath forgotten his Corſe, yet thus much he knoweth, that if he had ſailed vpon ſuch a Corſe, as that in 160. leages ſayling hee ſhould haue raiſed the Pole 3. degrees, hee ſhould then haue beene twiſe as farre from the Meridian as now hee is, and ſhould alſo haue beene ½ degree further to the Northwards then now hee is. I would now know what Corſe he hath ſailed, how many leages, and how farre he is ſeperated from the Meridian from whence hee began the ſaide Corſe.

A. She hath ſailed 88. leages Northweſt byweſt, and is 73. leages from the Meridian nereſt.

9 Q. Two Ships departing from one place, the one in ſayling 145. leags towards the Weſt, hath raiſed the Pole 4. degrees, and the other hath raiſed the Pole 7. degrees, and is 95. leages Weſt from the Meridian of the place from whence he began his corſe, I demaund by what corſe the ſaid ſhip hath ſailed, how farre they be aſunder, and by what corſe they may meete?

A. The firſt ſhip hath ſailed Northweſt byweſt, the ſecond hath ſailed Northweſt bynorth, 170 leages, they are aſunder 65. leags, and the corſe betweene them is North northeaſt, and South ſouthweſt.

10 Q. Two ſhips ſayling from one place, the one in ſayling 180. leages, is to the Eaſtwarde of the Meridian where hee began his corſe 150. leages, I demaund vpon what corſe and how many leages the other ſhip ſhall ſaile, to bring himſelfe 50. leages N.b.W. from the firſt ſhip?

A. The firſt ſhip hath ſailed N.e.b.e. and hath raiſed the Pole 5. degrees, the ſecond ſhip muſt ſaile Northeaſt bynorth 237 leages.

ALthough it may ſeeme (to ſome that be very expert in Nauigation) that theſe queſtions are needleſſe, and without vſe, being ſo plaine as not deſeruing in this ſorte to bee publiſhed, notwithſtanding that their opinion, I do in friendly curteſie aduiſe all yong practiſers of this excellent arte of ſayling, that they doe not onely by their Charts proue the trueth of theſe anſwered queſtions, but alſo indeuor themſelues to propound diuers other ſorts of queſtions, and in ſeeking their anſweres, to enter into the reaſon thereof: for by ſuch exerciſe, the yong beginner ſhal vnderſtand the ſubſtantiall grou̅ds of his Chart, and grow perfect therein: for whoſe eaſe and furderance onely, I haue at this preſent publiſhed this briefe treatiſe of Nauigation, knowing that the expert Pylote is not vnfurniſhed of theſe principles, but euery little helpe doth greatly further in euery beginning: and therfore for the further benefite of the practiſer, I haue hereunto annexed a perticular Sea Chart of our Chanell, commonly called the Sleue, by which all that is before ſpoken as touching the vſe of the Chart, may be practiſed, wherin the depths of the Chanell are truely laide downe: being an inſtrument moſt commodious and neceſſary for all ſuch as ſeeke the Chanel coming out of the occean Sea, much of it is from my owne practiſe, the reſt from Pylotes of very good ſufficiencie: I haue found great certaintie by the vſe of this Chart, for by the altitude and deapth I haue not at no time miſſed the true notice of my Ships being, which (through Gods mercifull fauour) by my land falls I haue alwaies found to be without errour, therefore haue it not in light regarde, for it will giue you great euidence, and is worthy to be kept as a ſpeciall iuell for the Seamans vſe, be he neuer ſo expert.

And thus hauing ſufficiently expreſſed all the practiſes appertaining to the skill of horizontal Nauigation, which kinde of ſailing is now of the greateſt ſort only practiſed, I think it good for your better memory briefly to reporte that which before is ſpoken as touching this kinde of Nauigation, and withall it will not bee a miſſe to ſhew you after what ſorte I haue beene accuſtomed to keepe my accomptes in my practiſes of ſailing, which you ſhall finde to be very ſure, plaine and eaſie: whereby you may at all times examine what is paſt, and ſo reforme the corſes laide downe vpon the Chart, if by chaunce there ſhould any errour be committed. And ſo concluding this parte of Nauigation, will in the next treatiſe make knowne vnto you the vſe of the Globe, ſuch vſes I meane as the Seaman may practiſe in his voyages, and that are moſt neceſſary for his knowledge.

A Table ſhewing the order how the Seaman may keepe his accompts, whereby hee may at all times diſtinctly examine his former practiſes, for in euery 24. howers, which is from noone to noone, hee doth not onely lay downe his latitude, with the corſe and leages, but alſo how the winde hath blowne in the ſame time.

The firſt Colume is the moneths and daies of the ſame, the ſecond is the obſerued altitude, the third is the Horizontall corſe or motion of the Ship, the fourth the number of leages that the Ship hath ſailed, the fiſth is a ſpace wherein muſt be noted, by what winde thoſe things haue beene perfourmed : and the next great ſpace is to lay downe any breefe diſcourſe for your memory.

	Anno. 1593.					
Monthes and daies of the month.	Latitude. G.	M.	Corſe.	Leages	Winde	The 23. of March, cape S. Auguſtine in Braſil, being 16. leags eaſt from me, I began this accōpt.
March. 24	7	30	N.N.E.	25	Eaſt.	
25	5	44	N.b.E, norly	36	E. b. N.	*Compaſſe varied 9. deg. the South point weſtward.*
26	4	1	N. b. N.	35	E.b.N.	*Compaſſe varied 8. deg. the South point weſtward,*
27	2	49	N.	24	E. b.N.	
28	1	31	N. eſterly.	26	E. b. N.	
29	1	4	N.N.W.	9	N. E.	*Compaſſe varied 6. deg. 40. m. the South point weſtward.*
Aprill. 31	0	0	N.b.W.	21	E.N.E.	*Obſeruation, the Pole artick aboue the Horizon.*
4	0	39	N.W.b.N.	15	N. E.	
7	1	53	N.N.W.	28	N. E.	
9	3	5	N.W.b. N.	30	N.E.b.E.	
10	4	5	N.W. b.N	22	N.E.	
11	4	45	N.W.	18	N.E.b.N.	
12	5	16	N.W.	14	N.E.b.N.	
13	6	11	N.W.b.N.	23	N.E.	
14	7	16	N.W.b.N.	24	N.E.	*Compaſſe varied 7. deg. the north point eaſtwards.*

A breefe repetition of that which is before ſpoken.

There are 3. kindes of Nauigation, Horizontall, Paradoxall, and ſayling vpon a great Circle, performed by Corſe and trauers.

A Corſe is the paradoxall line, which is deſcribed by the Ships motion vpon any point of Compaſſe.

A Trauers is the varietie of the Ships motion vpon euery alteration of Corſes.

The Compaſſe is an artificiall Horizon, by which Corſes and Trauerſes are directed, and containeth 32. pointes, and euery point containeth 11¼. degrees, or 45. minutes, being ¾ of an hower.

By ſuch quantitie of time as the Moone ſeperateth her ſelfe from the Sunne, by the like rate of time euery tide doth one differ from another.

In euery hower the tide altereth two minutes, in euery flud twelue minutes, and in euery ebbe twelue minutes, and in euery day 48. minutes, becauſe that ſo is the Moones ſeperation from the Sunne: for the Moone doth ſeperate her ſelfe from the Sunne, in euery day one point and 3. minutes, betweene the change and the full ſhe is to the Eaſtwardes of the Sun, and then is her ſeperation, at which time ſhe is before the Sunne in reſpect of her naturall motion, but in regarde of her violent motion, ſhe is then behinde or abaſt the Sunne.

Betweene the full and the change, ſhe is to the Weſtward of the Sunne, applying towards the Sunne, and then is her application, at which time ſhe is behinde ar abaſt the Sunne, in reſpect of her naturall motion, but in conſideration of her violent motion, ſhe is then before the Sunne.

She hath a violent motion, a naturall motion, a ſlowe, ſwift, and meane motion.

In euery 27. daies and 8. howers ſhe perfourmeth her naturall motion through the Zodiac.

Betweene change and change there is twentie nine daies, twelue howers, forty foure minutes nereſt.

The ſolar yeere conſiſteth of 12. moneths, and the lunar yeer of 12. Moones.

The Moones age is found by the Epact.

All inſtruments vſed in Nauigation, of what ſhape or forme ſoeuer they be, are deſcribed or demonſtrated vpon a Circle, or ſome portion of a Circle, and therefore are of the nature of a Circle.

A degree is the 360. parte of a Circle, how bigge or little ſoeuer the Circle be.

A degree is applied after 6. ſeuerall ſortes, to the Equator, to the Meridian, to the Horizon, to the verticall Circle, to meaſure, and to time.

Altitude is the diſtance, height, or mounting of one thing aboue another.

The Poles altitude is the diſtance betweene the Pole and the Horizon, or that portion of the Meridian which is contained betweene the Pole and the Horizon.

vertical

The altitude of the Sunne aboue the Horizon, is that portion of the circle ~~of Azumuth~~, which is contained betweene the Horizon and the Sunne.

Latitude is that arke of the meridian which is contained betweene the parallell of any place and the Equator, or that part of the Meridian which is included betweene the Zenith and the Equinoctiall.

Longitude is that portion of the Equator contained betweene the Meridian of S.Mihels, one of the Iles of the Aſſones, and the Meridian of the place whoſe longitude is deſired: the reaſon why the accompt of longitude doth begin at this Ile, is, becauſe that there the Compaſſe hath no variatiõ, for the Meridian of this Ile paſſeth by the Poles of the worlde and the Poles of the Magnet, being a Meridian proper to both Poles.

The longitude betweene place and place, is the portion of the Equator which is contained betweene the Meridians of the ſame places.

Declination is the diſtance of the Sunne, Moone and Starres, from the Equinoctiall, or that portion of the Meridian which paſſeth by the Center of any celeſtiall body, and is contained betweene the ſame center and the Equinoctiall.

Hidrographie is the deſcription of the ocean Sea, with all Iles, bancks, rocks and ſands therein contained, whoſe limits extend to the geographicall borders of the earth, the perfect notice whereof is the cheefeſt thing required in a ſufficient Pylote, in his excellent practiſe of ſayling.

Geographie is the deſcription of the earth onely, whereby the terreſtriall forme in his due ſituation is giuen, whoſe diſtinction is by mountaines, riuers, vallies, cities, and places of fame, without regarde of the Circles, Clymates, or Zones.

Coſmographie is the deſcription of the heauens, with all that is contained within the circute thereof, but to the purpoſe of nauigation, we muſt vnderſtand Coſmographie to be the vniuerſall deſcription of the terreſtriall Globe, diſtinguiſhed by all ſuch circles, by which the diſtinction of the celeſtiall Sphere is vnderſtoode to be giuen, with euery Countrie, Coaſt, Sea, Harborow, or other place, ſeated in ~~in~~ their true longitude, latitude, Zone, and Clyme.

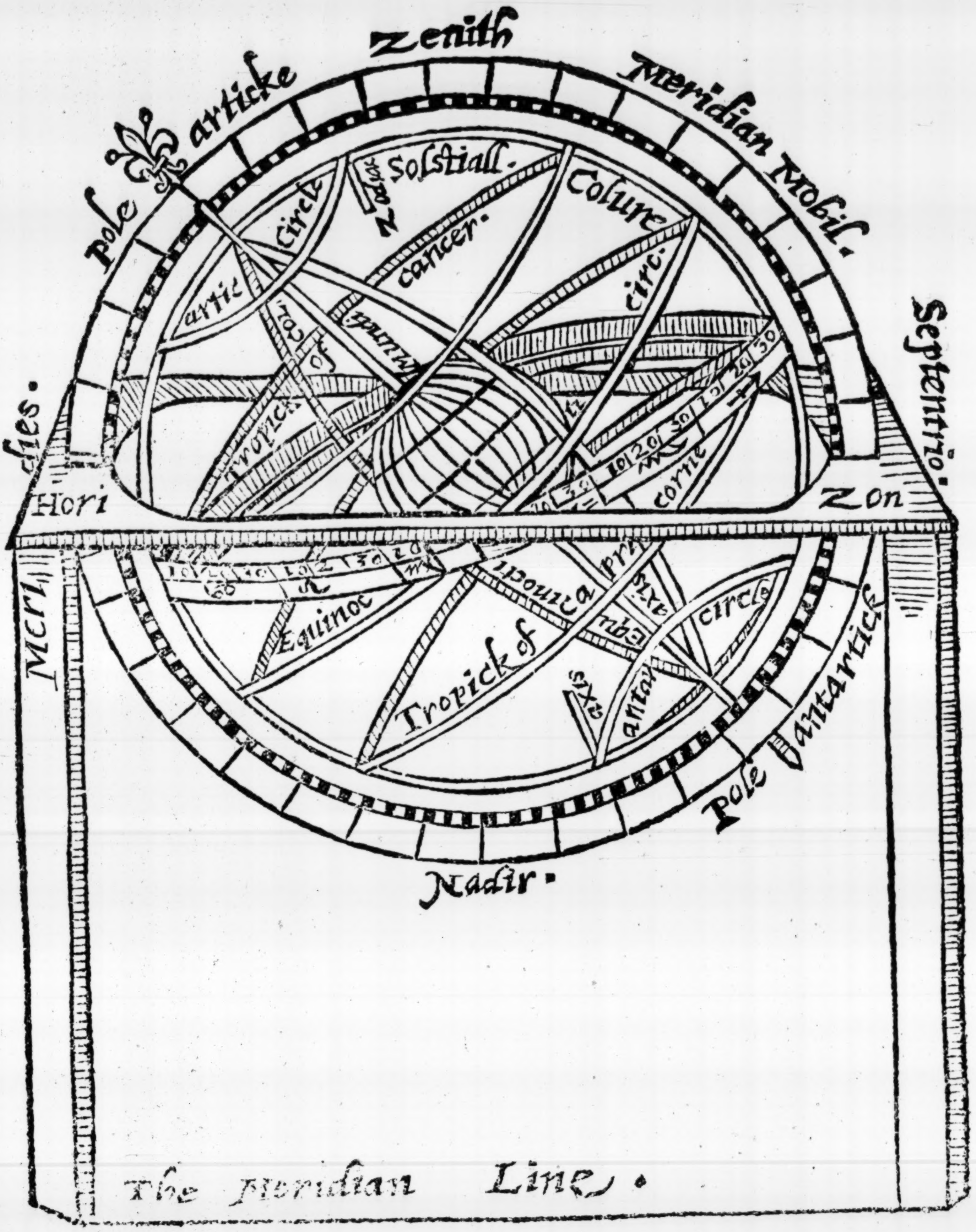
The Chart is a ſpeciall inſtrument in Nauigation, pretending the Coſmographicall deſcription of the terreſtriall Globe, by all ſuch lynes, circles, roſes and diuiſions as are required to the moſt exquiſite ſkill of nauigation.

The end of the Firſt Booke.

THE
SECOND PART
OF THIS TREATISE
OF NAVIGATION.

WHERIN IS TAVGHT, THE
nature and moſt neceſſary vſe of the Globe, with the Circles,
Zones, Climates, and other diſtinctions to the
perfect vſe of Sayling.

By which moſt excellent Inſtrument is perfour-
med, all that is needfully required to the
full perfection of all the three kindes
of Nauigation.


Zenith
pole artticke
Meridian Mobil.
Solstiall. Colure
Zodiac
cancer.
artic circle
circ.
Tropick of
Septentrio.
Meri dies.
Hori zon
10 20 30
capricorne
Equinoc.
Tropick of capricorne
axis
antartick circle
Pole antartick
Nadir.
The Meridian Line.

THE SECOND BOOKE OF THE SEAMANS SECRETS.

What is the Sphere?

THe Sphere is a ſolide body, contained vnder one ſuperficies, in the midſt whereof there is a point or prick, which is the Center of the Sphere, from whence all right lines drawn to the circumference, are equall the one to the other, whereby it is to be vnderſtoode, that the centre of the Sphere is ſo euenly placed in his midſt, as yͭ it hath like diſtance from all parts of the Circumference. And foraſmuch as the Sphere is an inſtrument demonſtrating vnto vs the vniuerſall ingine of the world, we muſt therfore vnderſtand this Center to be this terreſtrial Globe, wherin we haue our being, which compared to the celeſtial Globe or heauenly circumference doth beare ~~propertie~~, as yͤ center to his circle: which earthly globe by the diuine mightie workmanſhip of God, doth admirably hang vpon his center, being of equall diſtance from all partes of the circumference.

proporcion

What are the diſtinctions of the Sphere?

THe Sphere is diſtinguiſhed by ten circles, whereof ſixe are great circles, and 4. are leſſer circles: whereof there are onely 8. deſcribed vpon the body of the Globe, limiting the Zones and motion of the Planets, as the Equinoctiall, the Ecliptick, the Equinoctiall Colure, the Solſticial Colure, the Tropick of Cancer, the Tropick of Capricorne, the Artick Polar Circle, and the Antartick Polar Circle. The Horizon and Meridian are not deſcribed vpon the body of the Globe, but artificially annexed thereunto for the better perfection of his vſe.

Which are the great circles, and which the leſſer?

THe Equator, the Ecliptick, the 2. Colures, the Meridian and the Horizon are great circles, becauſe they deuide the ſphere into 2. equall parts. The 2. Tropicks, the 2. Polar circles, are leſſer circles, becauſe they deuide the Sphere into 2. vnequall partes.

What is the Equator or Equinoctiall?

THe Equinoctial is a great circle deuiding yͤ Sphere into 2. equal parts, leauing the one halfe towardes the North, and the other halfe towards the South, and is equally diſtant from both the Poles of the worlde 90. degrees, placed euenly betweene them, and deſcribed vpon them, this line croſſeth the Horizon in the true points of Eaſt and Weſt, and hath alwaies his owne halfe aboue the Horizon, vnles it be vnder either of the Poles, for there the Equator is in the Horizon: it croſſeth the Meridian at right Spherick angles, and it alſo croſſeth the Ecliptick line in the firſt minute of Aries and Libra, diuiding the Ecliptick and Horizon, and is alſo by them deuided into two equall partes. This line is alſo deuided into 360. equall partes or degrees, which are the degrees of Longitude, beginning the account in the point of Aries, reckoning twoards the Eaſt, concluding the number 360. in the place where the firſt account began: viz, where the Equator doth interſecte the Ecliptick in the firſt minute of Aries, vnder which Meridian S. yles Mihels one of the ~~partes~~ of the aſſones is to be placed in the geographicall deſcription of the terreſtriall Globe.

What is the vſe of the Equator?

THe vſe of the Equinoctiall, is to know the declination of the Sunne, Moone & Starres, wherby the latitude of places is giuen, for that portion of the Meridian which is contained betweene the Equator and the Centre of the Sunne, Moone or Starres, is their declination: alſo by the Equinoctiall is knowne the Longitude of places, for a quarter of a great Circle being drawne from the Pole, to the place whoſe Longitude is deſired, and ſo continued to the Equinoctiall, that degree and minute in which the quarter circle dooth touch the Equator, is the Longitude of the ſame place, or if you bring any place (that is deſcribed vpon the Globe) whoſe Longitude you would know, vnder the Meridian of the Globe, that degree of the Equinoctiall that is then likewiſe directly vnder the Meridian is the Longitude deſired. When the ſunne commeth vpon the Equator, then the daies and nights are of one length through the whole worlde: and then the Sunne riſeth vpon the true point of Eaſt, and ſetteth vpon the true point of Weſt, and not els at any time. This circle being fixed in the firmament, is moued with the firſt mouer in euery houre 15, degrees, by which accompt in 24. houres his motion is perfourmed. And here note, that the degrees of the Equinoctiall haue a double application, the one to time, and the other to meſure: in reſpect of time 15. degrees make an houre, ſo that euery degree containeth but 4, minutes of time, but when his degrees haue relation to meaſure, then euery degree containeth 60. minutes, being 20 leags, ſo that euery minute ſtandeth for a mile after our Engliſh accompt.

But this allowance of 20. leags to euery degree of the Equinoctiall, in ſayling, or meaſuring of diſtances vpon the Eaſt and Weſt Corſes, is onelye when you are vnder the ſame, becauſe the Equinoctiall being a perallell, is likewiſe a great circle, and euery degree of a great circle is truly accompted for 20. leags, or 60. myles.

But in the reſt of the perallells where either of the Poles are eleuated aboue yͤ Horizon, if there you ſaile or meaſure vpon the Corſes of eaſt or weſt, there are not 20. Leags to be allowed to euery degree, becauſe ſuch perallelles are leſſer circles, therefore they haue the fewer number of leags to euery degree: ſo that the further you departe from the Equator, the leſſer are the perallelles, and the leſſer that any perallell is, the leſſer are his degrees, becauſe euery circle containeth 360. degrees, and as the circles and degrees are diminiſhed in their quantitie, in like ſorte the diſtance anſwerable to ſuch degrees, muſt abate, as their circles do decreaſe. And further know, that the Equator, is the beginning of all terreſtriall Latitude, and declination of the celeſtiall bodies.

What is the Ecliptick?

THe Ecliptick line is a greater circle, deuiding the ſphere into 2. equall partes, by croſſing the Equator in oblique ſort deuiding him, and being diuided by him into 2. equall partes, bending from the Equator towards the North and South 23. degrees, and 28. minutes, being in the firſt minute of Cancer and Capricorne, there determining the Tropicall limits, this line likewiſe deuideth the Zodiack, by longitude into 2, equall partes, and is deuided together with the Zodiac, into 12. equal portions called ſignes, and euery of theſe ſignes is deuided vpon the Ecliptick into 30. equall partes or degrees, ſo that this line is deuided into 360. degrees, vpon which line the center of the Sunne doth continually moue: this circle is deſcribed vpon his proper poles, named the Pole of the Zodiac, beeing in all his partes 90. degrees from either of them.

The Zodiac is a circle contrary to all the other, for they are mathematicall lines, conſiſting only of length, without breadth or thicknes: but the Zodiac hath latitude or bredth 12. degrees, whoſe limits are 6. degrees, of either ſide of the Ecliptick, wherein the Sunne, Moone and Planets perform their motions and reuolutions, the center of the Sunne onelye keeping vpon the Ecliptick, but the other Planets haue ſometime North latitude, and ſometime South latitude. And here you muſt vnderſtand, that the latitude of the Planets or Starres, is that portion of the eclipticall meridian which is contained betweene the center of the Planet or Star and the Ecliptick line, and their longitude is that portion of the line Ecliptick, which is contained betweene the ~~the~~ ſaide meridian and the eclipticall meridian that paſſeth by the poles of the Zodiac and the firſt minute of Aries.

The 12. deuiſions or ſignes of the Zodiac are theſe, Aries ♈, Taurus ♉, Gemini ♊, Cancer ♋, Leo ♌, Virgo ♍, Libra ♎, Scorpio ♏, Sagitari ♐, Capricorne ♑, Aquarius ♒, Piſces ♓: and theſe are their characters that ſtand by them.

The 7. Planets that keepe within the limits of the Zodiack are theſe, Saturne ♄, Iupiter, ♃, Mars ♂, Sol ☉, Venus ♀, Mercury ☿, Luna ☽: Saturne perfourmes his courſe through all the degrees of the Zodiac, once in euery 30. yeeres: Iupiter in 12. yeeres, Mars in 2. yeeres, the Sunne in 365. daies and 6. houres being one yeere, Venus and ♀ as the Sunne, and the Moone performeth her courſe in 27. daies and about 8. houres, through all the degrees of the Zodiac.

And note that this naturall motion of the Planets in the Zodiac, is from the Weſt toward the Eaſt, the diurnall motion is violent, cauſed by the firſt mouer, or primum mobile, who in euery 24. houres doth perfourme his circular motion from the Eaſt to the Weſt, carrying with him all other inferiour bodies whatſoeuer.

What is the vſe of the Zodiac?

By the Zodiac and Ecliptick is knowne the longitude and Latitude of any Celeſtiall body, either Planets or fixed Starres, for a quarter of a great circle drawne from the pole of the Zodiac to the center of any Planet or Star, and ſo continued vntill it touch the Ecliptick, that degree and minute where the ſaid quarter circle toucheth the Ecliptick, is the longitude of the ſaid body, which is to be accompted from the firſt minute of Aries, for the longitude of Aries is the portion of the Ecliptick line, which is contained betweene the eclipticall meridian paſſing by the poles of the Zodiac, and the firſt minute of Aries, and the eclipticall meridian which paſſeth by the poles of the Zodiac and the centre of any Planet or Starre.

When the Planets are vpon the North ſide of the Ecliptick, they haue North latitude, and being South from the Ecliptick, they haue South latitude.

Alſo the motions of the Planets, the time of any Eclipſe, and the Suns declination by his place in the Ecliptick, are known by this circle, whoſe vſe is very ample and to great purpoſe, for all Aſtronomicall conſiderations.

What are the Colures?

The Solſticiall Colure is a great circle paſſing by the Poles of the world, and the poles of the Zodiac, and the Solſticial points or firſt minute of ♑ and ♋, cutting the Equinoctiall at right ſpherick angles, in his 90. and in his 270. degrees.

The Equinoctiall Colure is likewiſe a great circle paſſing by the poles of the worlde, and the equinoctiall point of ♈ and ♎, and croſſeth the equator in his firſt and 180. degrees, and thoſe Coloures do interſect ech the other in the poles of the world to right ſpherick angles.

What is the vſe of theſe Colures?

Their vſe is to diſtinguiſh the 4. principall ſeaſons of the yere, Spring, Summer, Autumne, and winter, deuiding the Equator and Ecliptick into 4. equal parts: alſo that arke of the Solſticiall Colure which is included betweene the firſt minute of ♋ and the Equinoctiall, is the Sunnes greateſt declination toward the North, the like arke being betweene the tropicall point of ♑ and the Equator, is the Sunnes greateſt South declination, being in theſe our daies 23 degrees, 28. minutes.

What is the tropick of Cancer?

The Tropick of ♋ is one of the leſſer circles deuiding the ſphere into two vnequall partes, and is deſcribed vpon the pole Artick, a perallell to the Equator 23. degrees 28 minutes from him, being the fartheſt lymit of the Ecliptick bending towards the North, to which when the Sunne commeth, the daies are then longeſt to all thoſe that inhabit in the North partes of the worlde, and ſhorteſt to the Southerne inhabitants: betweene this circle and the Equator are included the 6. Septentrional ſignes, ♈, ♉, ♊, ♋, ♌, ♍, in which ſignes during the time that the Sunne abideth, being from the 11. of March, to the 13. of September, he hath ~~much~~ north declination, and then is the ſpring and Summer to all ſuch as inhabite in the North partes of the Worlde, and Autumne and Winter to the inhabitants of the South partes of the Worlde: this circle doth touch the Ecliptick in the firſt minute of ♋, where the Sun beginneth his returne toward the South, wherupon it tooke the name Tropick, which ſignifieth conuerſion or returne, by which point of the Ecliptick, the diurnall motion deſcribeth this Circle.

What is the tropick of Capricorne?

The Tropick of ♑, is one of the leſſer circles deuiding the ſphere into 2. vnequall partes, and is deſcribed vpon the pole Antartick, a perallell to the Equinoctiall 23. degrees 28 minutes from him, being the fartheſt bending of the Ecliptick towards the South, to which when the Sunne commeth, the daies are then longeſt to al thoſe that inhabite in the South partes of the worlde, and ſhorteſt to the Northern inhabitants: betweene this circle and the Equator are included the 6. Southern ſignes, ♎, ♏, ♐, ♑, ♒, ♓, in which ſignes during the time that the Sunne abideth, being from the 13 of September to the 11. of March, he hath South declination, and then is the Spring and Summer to all ſuch as inhabite in the South partes of the worlde: and Autumne and Winter, to all the inhabitants in the North partes of the worlde: this circle toucheth the Ecliptick in the firſt minute of ♑, by which point the diurnall motion deſcribeth this perallell.

What is the vſe of the Tropicks?

By the Tropicks the Sunnes declination is known, as alſo the tropicks by the Sunnes fartheſt motion towardes the North and South, for ſo much as the Tropicks are diſtant from the Equator, ſo much is the Sunnes greateſt declination: and ſuch as is the Suns greateſt declining, ſuch is the diſtance betweene the Tropicks and the Equator: they are alſo the limits of the burning Zone, ſeperating the burning and temperate zones. For between the two Tropicks is contained the burning Zone.

What is the Artick polar Circle?

THe Artick Polar Circle is one of the leſſer circles, deuiding the ſphere into two vnequall partes, and deſcribed vpon the Pole Artick in perallell, to the Tropick of ♋, hauing ſuch diſtance from the Pole as the Tropick hath from the Equator, being 23. degrees 28. minuts, vpon which circle the Artick pole of the Zodiac is placed, which being fixed in the firmament, by the vertue of the firſt mouer is carried about with the heauens, by which motion this circle is deſcribed.

What is the Antartick polar Circle?

THe Antartick polar circle is oppoſite to the Artick, and perallell to the Tropick of ♑, being in all reſpect of ſuch diſtance and deſcription, from and about the pole Antartick, as the Artick polar circle is about the Pole Artick.

What is the vſe of the Artick and Antartick polar Circles?

THe vſe of theſe 2. polar Circles, is to ſhew the diſtance of the poles of the Zodiac, from the poles of the Worlde, for ſo much as the Solſticiall points are diſtant from the Equator, ſo much are the poles of the Zodiac from the poles of the Worlde: theſe circles doo alſo deuide and limit the temperate and frozen zones, for betweene the Tropick of ♋ and the Artick Polar circle is contained the Northern temperate zone, and betweene the Artick polar circle and the Pole artick, that is, within the Artick polar circle is contained the Northern frozen zone. Alſo betweene the Tropick of ♑ and the Antartick polar circle, is contained the Southern temperate zone, and within the ſaid polar circle is included the Antartick frozen zone, and theſe are all the circles that are deſcribed vpon the body of the Globe.

What is the Meridian?

THe Meridian is a great circle paſſing by the Poles of the Worlde, and by your zenyth, deuiding the Horiſon into 2. equall partes, in the pointes North and South, it alſo deuideth the ſphere with all the perallell circles therein contained, into 2. equall partes, croſſing them at right ſpherick angles. And this Meridian is not fixed in the firmament as the reſt of the circles are, for if it were, then ſhould it be moued with the firſt mouer as the reſt are, but it is not ſo: therefore the Meridian is manifeſted vpon the Globe, by a circle or ring of copper faſtened vnto the Globe, vpon the 2. Poles, ſo that the Globe moueth round vpon his 2. Poles within the Meridian: this Meridian is graduated in euery of his quarters into 90. degrees, by which his vſe is perfourmed: and note that one Meridian may haue many Horyzons, yet euery Horizon hath but one Meridian, for if you trauaile South or North, you keepe ſtill vpon the ſame Meridian, yet in euery ſencible difference of diſtance you ſhall enter into a change of Horizons, for there bee as many Horizons as there be ſencible differences of diſtance, and there bee as many Meridians as there be ſencible differences of diſtance, ſo that the difference be not vpon the points North or South, but this copper Meridian annexed to the Globe, is to be applyed to all differences and diſtances whatſoeuer, as amply as if the number were infinite.

What is the vſe of the Meridian?

The vſe of the Meridian is to know the higheſt aſcending of the Sunne, Moone or Starres from the Horizon, for when they bee vpon the Meridian, then are they fartheſt from the Horizon, and then is the moſt conuenient time to take the altitude of the Sunne or Starres, thereby to finde the Poles eleuation.

By the Meridian of your Globe is knowne the latitude and longitude of any place vpon the Globe contained, for if you bring any place vnder the Meridian, the degrees of the Meridian do ſhew the latitude of the ſame, and that degree of the Equator which the Meridian doth croſſe is the longitude, &c.

What is the Horizon?

The Horizon is a great circle deuiding the heauens into 2. equall partes the one halfe being aboue the Horizon is alwaies in ſight, the other halfe is not ſeene being vnder the Horizon, and therefore is called the finitor or lymit of our ſight, for where the heauens and ſeas ſeeme to ioyne together, that is the Horizon: the Horizon is not fixed in the firmament, and yet is a fixed circle conſtant to his proper latitude, but becauſe in the Globe one and the ſame Horizon may perfourme whatſoeuer is required to all eleuations, the Horizon is ſo artificially annexed to the Globe, that by the motion of the Meridian, in the ſame there faulteth nothing in his vſe: and the Horizon is in all reſpects diſtinguiſhed, as is the ſea Compaſſe. There are two kindes of Horizons, a right Horizon, and an oblique Horizon: when the Poles are in the Horizon, then is it a right Horizon, for then the Equator doth cut the Horizon to right angles, making a right Sphere and a right Horizon, an oblique Horizon is where either of the Poles are eleuated aboue the ſame, for then the Equator doth cut the Horizon to vnlike angles, making an oblique Sphere, and an oblique Horizon, and although the Horizons be diuers and many in number, for euery ſencible difference of diſtance hath his proper Horizon, yet is the Horizon of the Globs ſo conueniently annexed thereunto, as that by the mouing of the Meridian in the Horizon, and by the Globes motion in the Meridian, both the Horizon and Meridian are to be applyed as proper to all places whatſoeuer: and note that the place where you are, is alwaies the center of the plaine ſuperficiall Horyſon.

What is the vſe of the Horizon?

The Horizon is the beginning of all altitude, for whatſoeuer is aboue the Horyzon, is ſaid to haue altitude more or leſſe, and by the Horizon ſuch altitudes are giuen with helpe of the croſſe ſtaffe, for placing the croſſe ſtaffe at your eye, if by the one end of the tranſuerſary you ſee the Horyzon, and by the other end (at the ſame inſtant) you ſee the body obſerued, then doth the tranſuerſary ſhew vpon the ſtaffe the altitude deſired, by the Horizon the nauigable courſes from place to place are likewiſe knowne, as alſo the quantitie of the riſing and ſetting of the Sunne, moone and Starres: whereby is knowne the length of the daies and nights in all climats and at all ſeaſons: by the Horyzon is knowne vpon what degree of Azumuth, the Sun, Moone or Starres are, when they may be ſeene, in what part of the Heauen ſoeuer, whereby the variation of the Compaſſe is found, and the Poles altitude may at all ſeaſons be giuen.

Are theſe all the circles appertaining to the Globe?

There are other Circles which are fixed and doe properly appertaine to euery perticuler Horizon, as Azumuths, Almicanta~~p~~rs, the Artick, and Antartick circles.

What are circles of Azumuth?

Circles of Azumuths, or verticall circles, are quarters of great circles, concurring together in the Zenith, as the Meridians do in the Pole, and are extended from the Zenith to euery degree of the Horizon, &c. And becauſe they cannot be conueniently deſcribed vpon the Globe to bee applyed to all Horizons, therefore vpon the Meridian of the Globe there is a peece of copper artificially placed, to be remoued to any degree of the Meridian at pleaſure, which peece of copper repreſenteth the zenith, and muſt alwaies be placed ſo many degrees from the Equator, as the Pole is eleuated from the Horizon: and vnto this zenith there is ioyned a quarter of a great circle called Quarta altitudo, the ende whereof doth continually touch the Horyzon, and is ſo ioyned to the zenith, as that it may be moued round vpon the Horizon, and to euery parte thereof at your pleaſure: this Quarta altitudo is deuided into 90 degrees, being the diſtinction of all altitude, and beginneth the accompt from the Horizon, which is the beginning of altitude, and concludeth 90, degrees in the zenith, being the end and extreme lymite of all altitude.

What are Almicanta~~p~~rs?

Almicanta~~p~~rs or circles of altitude, are parallel circles to the Horizon, and are deſcribed vpon the zenith, as the perallells to the equator, are deſcribed vpon the Poles, of which circles there are 90. anſwerable to the diſtinctions of the Quarta altitudo, which are the degrees contained betweene the Horizon and zenith, theſe circles cannot be deſcribed vpon the Globe, to be applyed to euery Horizon, but they are diſtinguiſhed by the circular motion of the Quarta altitudo, for if I deſire to ſee the almicantar circle of 10. degrees, by mouing the Quarta altitudo round about the Horizon, the zenith degree of their quarter circle, doth ſhew the Almicanter deſired, in what eleuation ſoeuer.

What is the vſe of theſe two Circles?

THe quarta altitudo perfourmeth the vſe of both, by the quart[illegible] altitudo and Horizon the courſes from place to place are known according to the true horizontall poſition, as hereafter ſhall plainely appeere: it alſo ſheweth the degree of Azumuth, and obſerued altitude of any celeſtiall body, in what latitude ſoeuer: by the Quarta altitudo and Horizon, you may deſcribe a peradoxall Compaſſe vpon the Globe, the Poles ~~length~~ height is at all times thereby to be knowne, and the variation of the Compaſſe is thereby likewiſe giuen, as hereafter in the practiſe you ſhall be taught.

What are the Artick and Antartick circles?

EUery Horizon hath his proper Artick or Antartick circle, thoſe Horizons that haue the Pole Artick eleuated aboue them, haue their proper Artick circle, and thoſe that haue the South pole eleuated, haue their proper Antartick circle, the quantitie of which circle is according to the Poles eleuation, for if the Pole be much eleuated, then is the Artick circle great, for the Poles altitude is the ſemidiamiter of this circle, if the Pole be in the Zenith, then halfe the Heauens is the Artick circle.

What is the vſe of this circle?

IF the Sunne, Moone, or any Starres be within this circle, they are neuer caried vnder the Horizon during the time of their abode therin, wherupon it commeth to paſſe that ſuch as trauaile farre towards the North, haue the Sunne in continuall viewe, and thoſe that inhabite vnder the Pole (if any ſo doe) the Sunne is in continuall ſight for ſixe moneths together, becauſe the ſixe Septentrionall ſignes are within their Artick circle, the Equator being in the Horizon, &c.

There is another ſmall circle, which is called Ciclus horarius, or the hower circle, to be annexed to the Meridian of the Globe, for the perfection of his vſe, this circle muſt be deuided into 24. equall partes or howers, and thoſe againe into ſuch partes as you pleaſe for the better diſtinction of time: this circle muſt be faſtened to the meridian, ſo that the howers 12. muſt ſtand directly vpon the edge of the meridian, and the Pole muſt bee the center of this circle, vpon which Pole there muſt be faſtened an Index to moue proportionably, as the ſphere (vpon any occaſion) ſhall be moued.

There is alſo an halfe circle, called the Circle of poſition, which ſith it ſerueth to no great purpoſe for Nauigation I heere omit, and thus is the Globe fully finiſhed for the perfection of this vſe.

What are the Poles of the worlde?

THere are two Poles, the North or artick Pole, and the South or antartick Pole, which Poles are two im moueable prickes fixed in the firmament, inent, wherupon the ſphere is moued by vertue of the firſt mouer, and are the limits of the Axis of the worlde, as alſo the extreme terme or band of all declination, being 90. degrees from all partes of the Equator.

By the raiſing of the Pole from the Horizon, is knowne the perallell or latitude of our being, it alſo giueth the quantitie of the Artick circle, and the obliquitie of the ſphere.

What is the axis of the worlde?

The Axis of the worlde is a right line paſſing by the center of the ſphere, and limited in the circumference, about the which the Sphere moueth, and is therefore called the Axis of the Sphere, and as all lines comenſurable are limited betweene two pointes or pricks, ſo is the Axis of the worlde, and thoſe two limiting pricks are called the Poles of the worlde.

What are the Poles of the Zodiac?

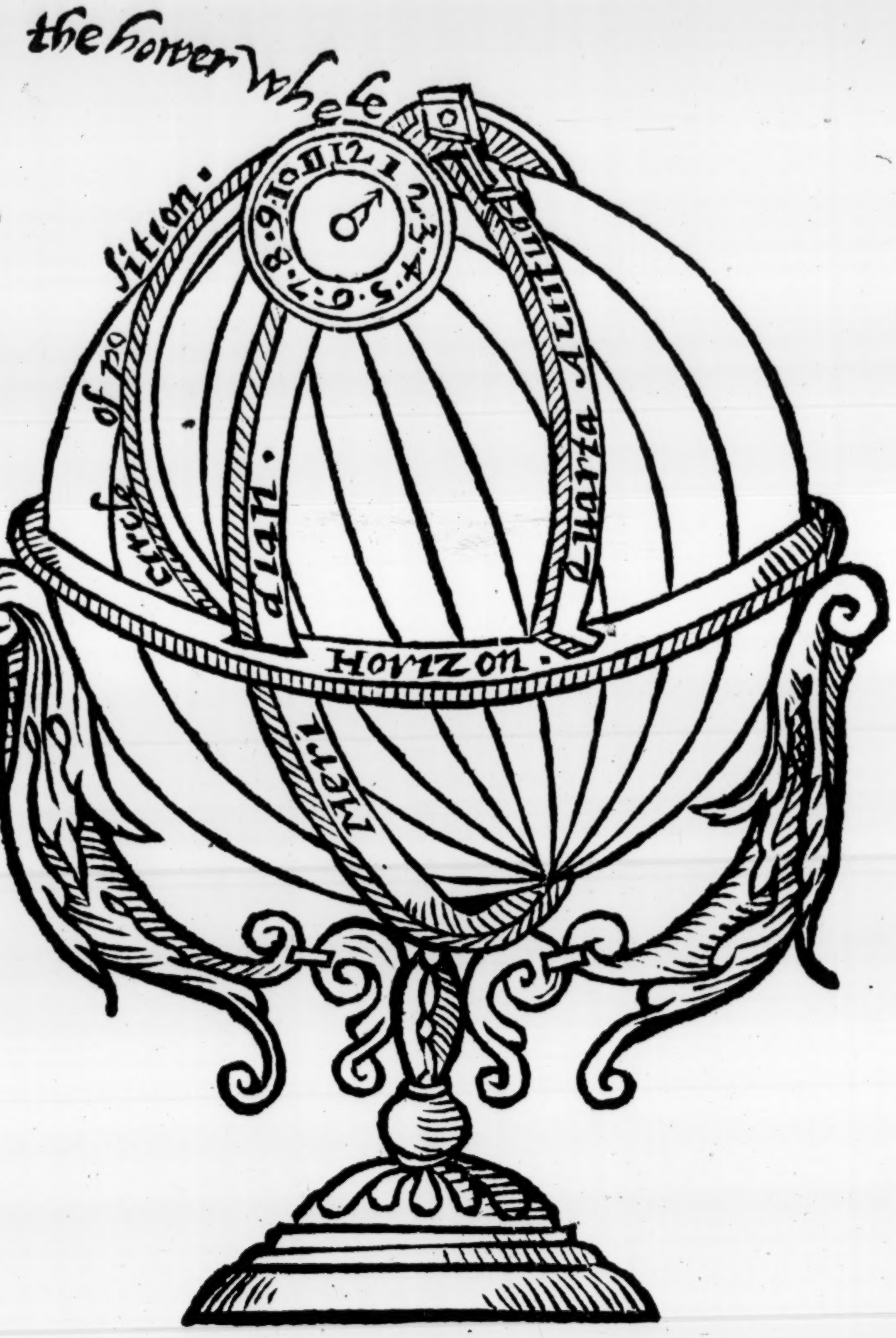
The zodiac hath likewiſe two Poles, Artick and Antartick, being two prickes fixed in the firmament, limiting the Axis of the zodiac, and are diſtant from the Poles of the world 23. degrees, 28. minutes, which Poles by the motion of the ſphere doe deſcribe the Polar circles, perfourming their motion about the Poles of the worlde in euery 24. howers, by vertue of the firſt mouer, vpon theſe poles the Ecliptick and zodiac is deſcribed: alſo a quarter of a great circle graduated into 90 degrees, being faſtened to either of theſe Poles and brought to the center of any Star, ſheweth by that graduation the latitude of the ſame Starre, and ~~retire~~ where the quarter circle toucheth the Ecliptick, that is likewiſe his longitude, alſo the 7. Planets do perfourme their naturall reuolutions vpon theſe Poles, whoſe motion is from the Weſt towards the Eaſt, coutrary to the motion of the firſt mouer.

What is the Axis of the Zodiac.

The Axis of the zodiac, is a right line paſſing by the center of the ſphere, and limited in the circumference, whoſe limiting pointes are the Poles of the zodiac, and this Axis is moued with the Sphere as are his Poles.

What are the Poles of the Horizon?

There are two Poles of the Horizon, which are the limits of his perpendicular dimetient, being equidiſtant 90. degrees from all parts of the Horizon, and are the extreme limits of all altitude, that Pole which is in the vpper Hemiſphere is called the zenith, and his oppoſite pole is called Nadir, they are extended to the firmament but not fixed in it, for they moue neuer, but remaine alwaies ſtable to ~~them~~ their proper Horizon, which could not be if they were fixed in the firmament, for then ſhould they be moued with the firmament as the reſt are, by the helpe of theſe Poles is found the Azumuth and Almicanter of any celeſtiall body, for a quarter circle deuided into 90. degrees, and fixed to the zenith as is the Quarta altitudo, being moued to any celeſtiall body, doth by thoſe degrees ſhew the almicanter or altitude of the ſame bodye from the Horizon, and that parte of the Horizon which the quarter circle teacheth, is the azumuth of the ſame body, alwaies prouided that the zenith ſtand anſwerable to the Poles eleuation, that is, ſo many degrees from the Equator, as the Pole is from the Horizon.



How many Zones are there?

There are 5. zones, 2. temperate zones, 2. frozen zones, and one burning zone, the burning zone lyeth between the two Tropicks, whoſe latitude is 46. degrees, 56. minutes, which zone by auncient Geographiers is reported to be not habitable, by reaſon of the great heat which there they ſuppoſed to be, through the perpendicularitie of the Sunne beames, whoſe perpetuall motion is within the ſaide zone, but we finde in our trauels, contrary to their reporte, that it is not onely habitable, but very populous, contayning many famous and mightie nations, and yeeldeth in great plentye the moſt pureſt thinges that by natures benefits the earth may procreate: twice I haue ſayled through this zone, which I found in no ſorte to bee offenciue,

bus

but rather comfortable vnto nature, the extremetie of whoſe heate is not furious but tollerable, whoſe greateſt force laſteth but 6. howers, that is, from 9. of the clocke in the morning, vnto 3. in the afternoone, the reſt of the day and night is moſt pleaſing and delightfull: therefore they did nature wrong in their raſh reporte.

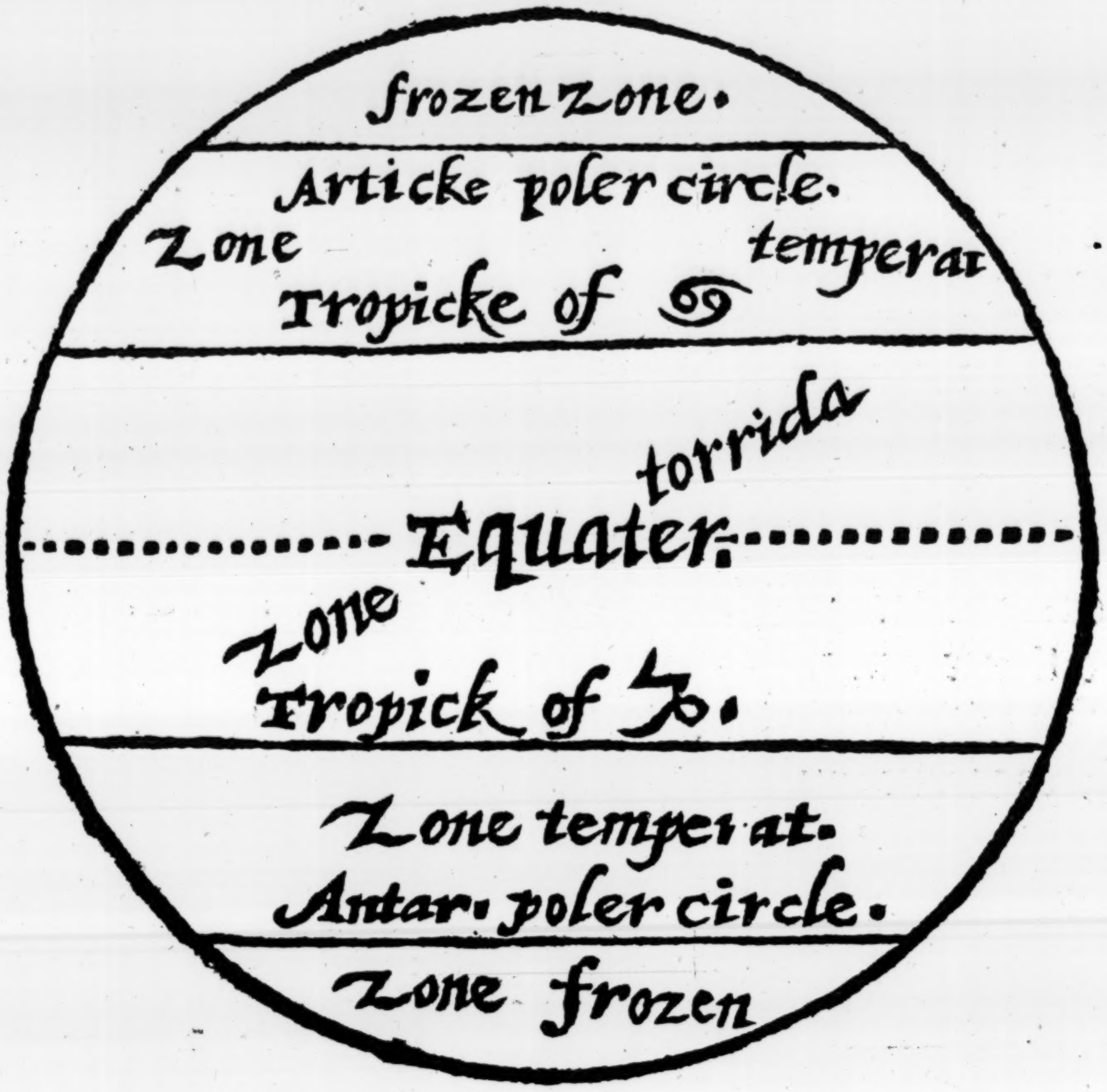
Of the frozen Zones.

THe frozen zones are contained within the polar circles, the Artick frozen zone within the Artick polar circle, and the antartick frozen zone within the Antartick Polar circle, which are alſo reported not to be habitable, by reaſon of the great extremetie of colde, ſuppoſed to be in thoſe parts, becauſe of the Sunnes farre diſtance from thoſe zones. but in theſe our dayes we finde by experience, that the auncient Geographiers had not the due conſideration of the nature of theſe zones, for three times I haue beene within the Artick frozen zone, where I haue found the aire very temperate, yea and many times in calme wether meruailous hot: I haue felt the Sunne beames of as forcible action within the frozen zone in calmes neere vnto the ſhore, as I haue at any time found within the burning zone. this zone is alſo inhabited with people of good ſtature, ſhape, and tractable conditions, with whome I haue conuerſed and not found them rudly barberous, as I haue found the Caniballs which are in the ſtraights of Magilane, and Southerne partes of America: In the frozen zone I diſcouered a coaſt which I named deſolation at the firſt viewe thereof, ſuppoſing ~~but~~ it by the loathſome ſhape to be waſte and deſolate, but when I came to an Ancker within the harbours thereof, the people preſently came vnto me without feare, offering ſuch poore thinges as they had to exchange for iron nailes and ſuch like: but the Canibals of America flye the preſence of men, ſhewing themſelues in nothing to differ from brute beaſtes: thus by experience it is moſt manifeſt that thoſe zones which haue beene eſteemed deſolate and waſte, are habitable, inhabited and fruitfull. If any man be perſwaded to the contrary of this truth, he ſhall doe himſelfe wrong in hauing ſo baſe an imagination of the excellency of Gods creation, as to thinke that God creating the worlde for mans vſe, and the ſame being deuided but into 5. partes, 3. of thoſe partes ſhould bee to no purpoſe: but let this ſaying therefore of the Prophet Eſaias be your ful ſatiſfaction, to confirme that which by experience I haue truely ſpoken: *For thus ſaith the Lord that created heauen, God himſelfe that framed the earth and made it, hee that prepared it, hee created it not in vaine, hee framed it to be inhabited, &c.* Eſai. 45, 18.

Of the temperate zones.

THe temperate Artick zone is included betweene the tropick of ♋ and the Artick Polar circle, whoſe latitude or bredth is 42, degrees, 2. minutes, within the which we haue our habitation.

The temperate Antartick zone is limited by the tropick of ♑ and the Antartick Polar circle, and hath breadth or latitude 42, degrees, 2, minutes.



What is a Climate?

A Climate is the ſpace or difference vpon the vpper face of the earth, included betweene two perallells, wherein the day is ſenſibly lengthened or ſhortned halfe an hower, for as you trauaile from the Equator toward the Artick Pole, the Sunne hauing North declination, the daies doe grow longer and longer, vntill at laſt the Sunne not ſetting vnder the Horizon, you ſhall haue continuall day, and euery ſpace or diſtance that altereth the day halfe on hower, is called a Climate: theſe Climates take their names from ſuch famous places as are within the ſaide Climates, of which there are 9. as by their diſtinctions may appeare.

1. The firſt paſſing through Meroe, beginneth in the latitude of 12.de. 45.m. and endeth in 20.d.30.m. whoſe bredth is 7.d.45.m.
2. The ſecond paſſing through Syene, beginneth in the latitude of 20.de. 30.m. and endeth in 27.d.30.m. whoſe bredth is 7.d.
3. The third paſſing through Alexandria, beginneth in the la. of 27.d.30.m

8

and endeth in 33.d.40.m. whoſe bredth is 6.d.10.m.

4. The fourth paſſing by Rhodes, beginneth in the la. of 33.d.40.m. and endeth in 39.d. whoſe bredth is 5.d.20.m.

5. The fifth paſſing by Rome, beginneth in the la. of 39.d and endeth in 43.d.30.m. whoſe bredth is 4.d.30.m.

6. The ſixt paſſing by Boriſthines, beginneth in 43.d.30.m. and endeth in 47.d.15.m. whoſe bredth is 3.d.45.m.

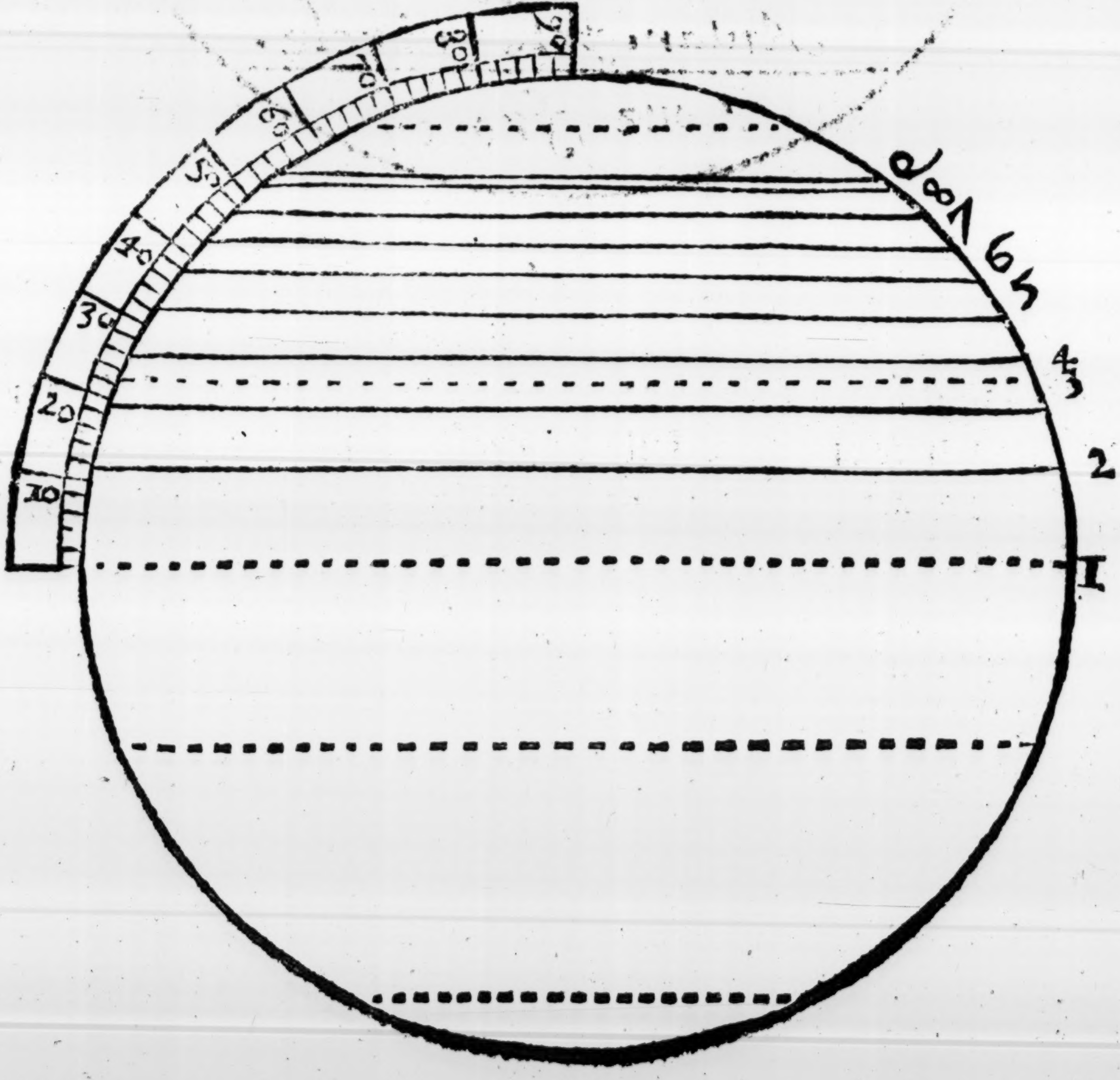
7. The ſeuenth paſſing by the Rhiphaan mountains, beginneth in 47.d.15.m. and endeth in 50.d.20.m. whoſe bredth is 3.d.5.m.

8. The eight paſſing by Meotis or London, beginneth in 50.d.20.m. and endeth in 53.d.10.m. whoſe bredth is 2.d.50.m.

9. The ninth paſſing by Denmarke, taketh his beginning in the latitude of 53.d.10.m. and endeth in the latitude of 55.d.30.m. and hath in bredth 2.d.20.m.

If you deſire to know how many leagues euery Climate is in bredth, allow for euery degree 20. leagues, or 60. miles, and for euery minute a myle, ſo is the diſtance giuen.

Thus haue I manifeſted vnto you all the diuiſions and perticularities of the Spheres diſtinction.



What is the vſe of the Globe?

The vſe of the Globe is of ſo great eaſe, certaintie and pleaſure, as that the commendations thereof cannot ſufficiently be expreſſed, for of all inſtruments it is the moſt rare and excellent, whoſe concluſions are infallible, giuing the true line, angle, and circular motion of any Corſe or trauers that may in Nauigation happen, whereby the longitude and latitude is moſt preciſely knowne, and the certainty of diſtance very plainelye manifeſted, according to the true nature thereof: it giueth the variation of the Compaſſe, and the howre or time of the day at all ſeaſons, and in all places. And by the Globe the Poles height may at all inſtants and vpon euery point or azumuth, of the Horizon, by the Sunnes altitude taken, be moſt preciſely knowne, by the certainty of whoſe excellent vſe, the ſkilfull Pilot ſhall receiue great content in his pleaſing practiſe gubernautick.

How are diſtances meaſured vpon the Globe?

When there are 2 places aſſigned the diſtance, betweene which you deſire to know, with a paire of circular compaſſes you muſt doe it in this ſort: ſet one foote of the Compaſſes vpon one of the places, and the other foote vpon the other place, the Compaſſes ſo ſtretched forth bring vnto the Equator, and as many degrees as may bee contained betweene thoſe two points of the Compaſſe, allowing 20. leages for euery degree is the diſtance deſired: or if the places be of ſuch diſtance, as that you cannot with your Compaſſes reach them, then take with the Compaſſes 5. degrees of the Equator, which is 100. leages, or 10. degrees for 200. leages, and ſo meaſure how often the diſtance is contained betweene the ſaide places, if any parte of a degree doth remaine, for halfe a degree allow 10. leages, for a quarter 5. leages, &c. but if you deſire a moſt exquiſite preciſenes in meaſuring to the minute, ſecond and third, then doe thus. When your Compaſſes doth fal vpon any parte of a degree, note the diſtance between the end of that degree and the point of the Compaſſes, then with a paire of conuenient compaſſes take the diſtance, then meaſure the ſame 60. times vpon the Equator, (beginning at ſome certaine place) then conſider how many degrees are contained within the meaſure, and allow euery degree to be a minute or myle, ſo are the leages and miles knowne, if any ~~perallell~~ of a degree remaine vpon parte this meaſure of minuts, do as at the firſt, meaſuring the ſame 60. times vpon the Equator, the degrees comprehended within yͤ meaſure, are ſeconds: if any parcell of a degree remaine vpon theſe ſeconds, do as in the firſt, and the degrees contained in this meaſure are thirds, and ſo you may proceed infinitly.

How may the Globe be rectified anſwerable to the true poſition of the heauens, for any place, Cittie, or promontery?

The place being knowne for the which you would rectifie the Globe, doe thus: bring the place vnder the Meridian, and there conſider the latitude thereof: and as many degrees as that place is from the Equator, ſo many degrees you muſt eleuate the Pole from the Horizon, then bring the zenith directly ouer the ſame place, and ſo is your Globe rectified for the execution of any practiſe: and without this ordering of the Globe, there is no concluſion to be executed by the ſame.

How is the longitude and latitude of places known by the Globe?

BY turning the Globe within the Meridian, you muſt bring the Promontery, Bay, Harborow, Cittie, or other place, (whoſe latitude and longitude you ſeeke) preciſely vnder the Meridian, there holding the Globe ſtedy, the degree of the Meridian that is directly ouer the ſaid place, ſheweth the latitude thereof, and that degree of the Equinoctiall which is directly vnder the Meridian, is the longitude of the ſame place.

How is the Corſe found betweene place and place?

TWo places beeing aſſigned, the Corſe betweene which you deſire to know, firſt ſeek the latitude of one of theſe places, and rectifie the Globe anſwerable vnto the ſame, as before is taught, then bring that place directly vnder the Meridian and Zenith, if both places be vnder your Meridian, they then lye North and South, if not, then bring the Quarta altitudo to the other place, and note vpon what parte of the Horizon the end of the ſame toucheth, for that is the preciſe Horizontall Corſe betweene the ſaid places, but this you muſt conſider, that the Horizontall Corſe is not the nauigable corſe, vnles the places be of ſmal diſtance, for if any place bare Northeaſt from me, or Eaſt from me, or vpon any other point, North or South excepted, and be diſtant 500. leages, if I ſayle vpon the Horizontall Corſe, I ſhall neuer ariue vnto the ſame place.

How then ſhall the Pylote ſaile by the Globe? if the matter be ſo doubtfull?

The ſkilfull Pylote that vſeth this excellent inſtrument, dooth firſt conſider the place from whence he ſhapeth his corſe, and rectifieth the Globe anſwerable to the ſame, then bringing the place directly vnder the Meridian and Zenith, there holding the Globe ſtedie, bringeth the Quarta altitudo to the place for which he is bound, the end whereof ſheweth vpon the Horizon the true Horizontall Corſe, vpon which Corſe he ſayleth 20. or 30. leages, and there maketh a note or prick by the edge of his Quarta altitudo, according to the true diſtance proued by Corſe, reconing an altitude as in the vſe of a Chart: then hee bringeth that prick or note vnder the Meridian, and there conſidereth the true latitude of his being, he then rectifieth the Globe anſwerable to the ſame prick, and keeping the ſame vnder the Zenith, dooth againe turne the Quarta altitudo to the place for which he is bound, the end wherof ſheweth vpon the Horizon the Horizontall Corſe, then ſayling as at the firſt he maketh a note or prick as before. and thus proſecuting his Corſe, ſhall arriue vnto his deſired place: but in this practiſe he ſhall plainely proue that his Horizontall Corſe will differ greatly, and that by his ſayling in this ſorte, he ſhall by his notes and pricks deſcribe the true nauigable and neereſt Corſes betweene the ſaid places: The like methode is to bee obſerued vpon any trauers or forced courſe whatſoeuer: and therefore the Pylote muſt take care, that although the winde be neuer ſo fauourable, yet hee muſt not proſecute any Horizontall Corſe (North and South only excepted.)

Therefore I ſay, the Pylote muſt take ſpeciall care to conſider the diſtance of places, whether the Horizontall Corſe will leade him betweene the ſaide places: for if places be more then 45. degrees aſunder, the Horizontall Corſe is not the meane to finde thoſe places, vnleſſe they lye North & South: for the Horizontall courſe betweene any 2. places, is a portion of a great circle, which being of large diſtance, muſt be perfourmed by great circle nauigation, and not by Horizontall Corſes: for the collection of many Horizontall Corſes being knit together, doe performe a peradoxall motion, altogether differing from a great circle, as for an example: being at Cape verde, there is a place diſtant from me 80. degrees, vpon the point Northweſt, vnto which place I deſire to ſayle, I therefore bring Cape verde vnder the Meridian of my Globe, there conſidering the latitude of the Cape, I rayſe the Pole anſwerable to the ſame, and place the Zenith directlye ouer the Cape, then turning the Quarta altitudo to the point Northweſt vpon the Horizon, all ſuch places as the ſaide Quarta altitudo then toucheth, doe beare due Northweſt from me: now proſecuting this Corſe by the direction of my Compaſſe, the firſt day I ſayle 20 leages, therefore I make a marke by the edge of the Quarta altitudo, 20. leages from the Zenith, then bringing that marke vnder the Meridian, I rectifie the Globe anſwerable to the latitude thereof, the next day I ſayle other 20. leages vpon the ſame point, and make a marke as at the firſt, I bring that marke likewiſe vnder the Meridian, and rectifie the Globe as before, and by this methode proſecuting the Corſe NW, I ſhall deſcribe a peradoxall lyne, which will leade me to the North of the place vnto which I would ſayle, the farther the diſtance, the greater the difference: by this order you may deſcribe peradoxall lynes, vpon all the points of the Compaſſe, but this is to be regarded, that your differences be as ſmall as you may, and that none of them exceed 20. leags, for by the ſmalleſt diſtinctions, is perfourmed the greateſt certaintie. And by the deſcription of theſe lynes, you may very manifeſtly vnderſtand the differences of Horizontall peradoxall and great circle Nauigation.

And this may ſuffiſe for the ſayling vſe of the Globe, conuenient for the ſeamans purpoſe.

What is great Circle nauigation?

GReat Circle nauigation is the cheefeſt of all the 3. kindes of ſayling, in whom all the other are contained, and by them this kinde of ſayling is perfourmed, continuing a Corſe by the ſhorteſt diſtance betweene places, not limited to any one Corſe, either horizontall or peradoxall, but by it thoſe corſes are ordered to the full perfection of this rare practiſe, whoſe benefites in long voyages are to great purpoſe, ordering and diſpoſing all horizontall trauerſes to a perfect concluſion: for there are many changes of horizontall and peradoxall Corſes in the execution of this practiſe, ſo that vpon the ſhifting of a winde, when that it may ſeeme that you are forced to an inconuenient Corſe by the ſkill of great Circle ſayling, that Corſe ſhall be found the ſhorteſt and onely proper motion to perfourme your voyage. And alſo when with fauourable windes the Pylote ſhall ſhape a Corſe by his Chart or Compaſſe peradoxall, as the beſt meane to attaine his porte, he ſhall by this kinde of ſayling finde a better and ſhorter Corſe, and by ſufficient demonſtration proue the ſame, ſo that without this knowledge I ſee not how Corſes may be ordered to their beſt aduantage: therefore ſith by it the perfection of ſayling is largely vnderſtoode, and the errors likewiſe moſt ſubſtancially controled, it may of right challenge the cheefeſt place among the practiſes Gubernautick. The perticularities whereof if I ſhould by an orderly methode labour to expreſſe, it would be a diſcourſe ouer large for this place, and as I thinke troubleſome if the premiſſes be not well vnderſtoode: therfore I will now ouerpaſſe it, vntill a time more conuenient and of better leaſure.

a a

Of peradoxall Nauigation.

PEradoxall Nauigation, demonſtrateth the true motion of the Ship vpon any Corſe aſſigned, in his true nature by longitude, latitude and diſtance, giuing the full lymit or determination of the ſame, by which motion lines are deſcribed neither circular nor ſtraight, but concurued or winding lynes, and are therefore called peradoxall, becauſe it is beyond opinion that ſuch lynes ſhould be deſcribed by plaine horizontall motion: for the full perfection of which practiſe I purpoſe (if God permit) to publiſh a peradoxal Chart with all conuenient ſpeede, and ſo will diſcouer by the ſame at large, all the practiſes of peradoxall and great Circle nauigation, for vpon the peradoxall Chart it will beſt ſerue the Sea-mans purpoſe, being an inſtrument portable, of eaſie ſtowage and ſmall practiſe, perfourming the practiſes of Nauigation as largely and as beneficially as the Globe in all reſpects: and all theſe practiſes of ſayling before mentioned, may in a generall name be aptly called Nauigation Geometricall, becauſe it wholy conſiſteth of Geometricall demonſtratiue concluſions.

But there is another knowledge of Nauigation, which ſo farre excelleth all that is before ſpoken, or that hath hitherto beene vulgarly practiſed, as the ſubſtance his ſhadowe, or as the light ſurpaſſeth the thick obſcured darkenes: and this ſweete ſkill of ſayling may well be called Nauigation arithmaticall, becauſe it wholy conſiſteth of Calculations, comprehended within the lymit of numbers, deſtinguiſhing Corſes not only vpon the points of the Compaſſe, but vpon euery degree of the Horizon, and giueth the diſtance of any trauers for the perticular eleuation of minutes, yea, and leſſe partes aſſure your ſelfe: it giueth longitudes and latitudes to the minute ſecond and third: in ſo great certaintie, as that by no other meanes the like can be perfourmed: it teacheth the nature of Angles and Triangles, aſwell Sphericall as plaine ſuperficiall and ſolide Comenſurations, the effect of lynes ſtraight, circular, and peradoxall, the quantities and proportions of perallells, the nature of Horizons, with euery perticular diſtinction of any alteration whatſoeuer, that may in Nauigation be required, to a moſt wonderfull preciſe certainty: for there can nothing be required, that by this heauenly hermonye of numbers ſhall not bee moſt copiouſlye manifeſted to the Seamans admiration and great content: the orderlye practiſe whereof to the beſt of my poore capacitie I purpoſe to make knowne, if I may perceiue my paines already taken, to be receiued in good parte, which I diſtruſt not but all honeſt minded Seamen, and Pylots of reputation wil gratefully embrace, onely in regarde of my friendly good will towards them, for it is not in reſpect of my paines, but of my loue, that I would receiue fauourable curteſie.

How may the Poles height be knowne by the Globe?

There are diuers waies to finde the Poles height by the Globe, aſwell from the Meridian as vpon the ſame, but ſith before I haue ſufficiently taught how by the Sunnes Meridian altitude, the Poles height may bee found, I will therefore in this place ſpeake no further thereof, but for the other kindes it may be knowne as followeth.

How by the Sunnes riſing or ſetting, the Poles height may be knowne.

By your Compaſſe of variation, or ſome magneticall inſtrument, obſerue at the ſunne riſing, vpon what degree of the Horizon the center toucheth, according to the true horizontall poſition of the Magnet, all variation dulye conſidered, that being knowne, ſearche in the tables of the Ephimerides, for the Sunnes place in the Ecliptick, at the time of your obſeruation, then bring that place or degree of the Ecliptick wherein you finde the Sunne to be, to the Horizon, and moue ~~that~~ the Meridian of the Globe as occaſion requireth, vntill that obſerued degree of the Horizon and the Sunnes place in the Ecliptick doe iuſtly touch together, for then is the Pole in his due Eleuation, as by the interſection of the Horizon and Meridian may appeare, in like ſorte you may finde the Poles altitude, by any knowne fixed Starre in the Horizon.

To finde the poles height by the Sunne, vpon any point of the Compaſſe.

By the Compaſſe of variation, rectified to the true horizontall poſition, obſerue the Sunne vntill he come to any point thereof at your pleaſure, and at the ſame inſtant take the ſunnes height from the Horizon, then bring the Quarta altitudo to that point of the Compaſſe vpon the Horizon of the Globe where you obſerued the Sunne to be, there holding the Quarta altitudo ſtedye, moue the Globe vntill you bring the degree of the Ecliptik (wherein the Sunne is at the time of your obſeruation) vnto the edge of the Quarta altitudo, if it fall vpon that degree of altitude as was the Sunnes obſerued height, then doth the Pole ſtand to his true Eleuation, but if it agree not, you muſt eleuate or depreſſe the Pole as occaſion requireth, rectifying the Zenith anſwerable thereunto. And againe make triall as at the firſt, bringing the place of the Sunne to the Quarta altitudo, and ſetting the ſame vpon the obſerued point of the Compaſſe, vntill it agree in all reſpects with your obſeruation, and then the Meridian ſheweth in his interſection with the Horizon, the Eleuation of the Pole from the Horizon.

To finde the Poles height by any giuen Azumuth by the Sunne being aboue the Horizon.

By your magneticall inſtrument, or Compas of variation obſerue the azumuth of the Sunne at any time in the forenoone, or afternoone, the neerer the Sun is to the Horizon, the better ſhalbe your obſeruation, and at the ſame inſtant take the height of yͤ Sun from the Horizon, keep theſe 2. numbers in memory, and note that the Azumuth be obſerued according to the true poſition of the Horizon, by hauing good regarde to the variation of yͤ compas, then bring the Quarta altitudo to the place of the Sun in the Ecliptick, and ſet that degree of the Sunnes place in the Ecliptick vpon the obſerued degree of altitude by the graduation of the Quarta altitudo, and if the end thereof at the ſame inſtant doe fall right vpon the obſerued degree of Azumuth, then is the Pole in his due Eleuation: if not, then raiſe or lay the Pole as occaſion requireth, alwaies regarding that you place the Zenith anſwerable to the Poles altitude, and then againe bring the Sunnes place to his altitude vpon the Quarta altitudo, and looke againe whether the end thereof doe touch the obſerued degree of Azumuth vpon the Horizon, if not, you muſt proſecute this order, vntill at one inſtant the place of the Sunne be vpon his true almicanter, by the edge of the Quarta altitudo, and that the end of the quarta altitudo doe alſo touch the obſerued degree of Azumuth vpon the Horizon, for then is the Pole in his true eleuation, as by the Meridian and Horizon will appeare.

To finde the Poles height by the Sunne, by any two giuen azumuths and altitudes, not regarding the true horizontal poſition or nedles variations.

BEcauſe there may great errors be committed in the former obſeruations vnleſſe the Compaſſe be perfectly well rectified, ſo as it may reſpect the true partes or diſtinctions of the Horizon, it is not amiſſe to enforme you how without regarde of variation, the Poles height may be found.

Therefore by your Magneticall inſtrument or Compaſſe of variation obſerue the Sunnes azumuth, without regarde of the true horizontall poſition, and at the ſame inſtant obſerue alſo his altitude from the Horizon, keepe thoſe two numbers in memory. then after the Sunne hath moued a point or two points of the Compaſſe more or leſſe at your diſcretion, obſerue again his azumuth and altitude as at the firſt, then conſider the arke of the Horizon through which the Sunne hath moued betweene theſe two obſeruations, for by the 2. obſeruations of the Sunnes altitude, and by the degrees of Azumuth through which the Sunne hath moued, the Poles height is thus knowne: Firſt ſet the Globe to the eleuation of the place wherein you are as neere as you can geſſe, and bring the Zenith to the like latitude from the Equator, as the Poles eleuation is from the Horizon, then bring the Quarta altitudo to the place of the Sunne vpon the Ecliptick, for the time of your obſeruation, there place the Sunne vpon the firſt obſerued altitude by the degrees of the quarta altitudo, and note the degree of the Horizon which the Quarta altitudo then toucheth: this done, bring the Sunnes place to the ſecond obſerued altitude, by mouing the Quarta altitudo and the Globe vntill the degree of the Sunnes place in the Ecliptick and the degree of his altitude vpon the Quarta altitudo doe meete. Then againe conſider the degree of the horizon which the end of the Quarta altitudo toucheth, and note the Arke of the Horizon contained betweene your 2. obſeruations, of how many degrees it conſiſteth, if it agree with the obſeruations made by your Magneticall inſtrument, then doth the Pole ſtand in his true altitude, if not you muſt either raiſe or depreſſe the Pole, and againe proſecute the former practiſe, vntill you finde ſuch azumuths and altitudes vpon the Globe, as you found by your Magneticall obſeruations, for then the Pole doth ſtand in his true altitude, and then doth alſo appeare the true azumuth of both your obſeruations, which if it agree not with your Compas, then is your compas varied, and may heereby be corrected, ſo that this doth not onely giue the Poles height, but alſo the true horizontall poſition without error.

To finde the Poles height by taking the Sunnes altitude aboue the Horizon, ſo that the preciſe time of any ſuch obſeruation be knowne.

IF You deſire at any time of the day to know the Poles height, as at 8, 9, or 10. of the clocke, &c. marke diligently the time of your obſeruation, at what inſtant you doe obſerue the Sunnes altitude from the Horizon, the time and altitude thus knowne, bring that place of the Ecliptik wherin the Sunne is at the time of your obſeruation directly vnder the Meridian, there holding the Globe ſtedye, bring the Index of the Ciclus horarius to the hower of 12, or noone, then moue the Globe vntill the Index come to the hower of your obſeruation, there holde the Globe ſtedy, then bring the quarta altitudo to the place of the Sunne in the Ecliptick, if it agree with your obſerued altitude, then doth the Pole ſtand in his true eleuation, if not, moue the Meridian by raiſing or depreſſing yͤ pole as occaſion requireth, vntill you bring the altitude & the hower to agree, and then you haue the Poles height, and by the end of the quarta altitudo doth alſo appere the degree of azumuth, wherupon the Sunne was at the time of your obſeruation, and note that in rayſing or depreſſing the Pole of the Globe, you muſt alſo place the Zenith ſo farre from the Equinoctiall, as the Pole is from the Horizon, for this is a generall rule, that ſo much as the Pole is eleuated from the Horizon, ſo much is the latitude of the Zenith from the Equator, therefore you muſt alwaies bring the Zenith and altitude to agree, whenſoeuer you alter the Eleuation be it neuer ſo little.

To finde the Poles height by any two obſeruations of the Sunnes altitude, not regarding the hower of the day, or any horizontall poſition of the Magnet, ſo that you know the diſtance of time between the ſaid obſeruations.

ALthough there be ſome difficultie in giuing the true time of any obſeruations at the Sea, by reaſon of the alteration of Horizons, and of the needles variation, yet it is a matter moſt eaſie by a good hower Glaſſe, halfe hower Glaſſe, and minute Glaſſe, to meaſure the diſtance of time betweene any two obſerued altitudes, you may therefore vpon that ground finde the Poles height with great facilitie at any time, by the Sunne or any fixed Starre, in this ſorte.

Conſider in what place of the Ecliptick the Sunne is at the time of your obſeruation, bring that place to the Meridian, there with a black leade by mouing the Globe deſcribe a perallell to the Equator, anſwerable to the Sunnes diurnall motion and declination for the ſame inſtant, then if betweene your obſeruations there be an hower, two howers, more or leſſe at your pleaſure, as by your running glaſſes may be knowne, you muſt allowe for euery hower 15.d, of the Equator, for ſo much aſcendeth euery hower, and for euery 4. minutes one degree, and for euery minute ¼ of a degree, then knowing by this order how many degrees the Sunne is moued betweene your 2. obſeruations, you muſt vpon the perallell which you drawe make 2. notes, ſo many degrees aſunder as the Sunne hath moued betweene your obſeruations, which may be done in this ſorte: bring the place wherein the Sunne is vnder the Meridian, and mark what degree of the Equator is then vnder the Meridian, the Globe ſo ſtanding vpon your perallell cloſe by the Meridian, make the firſt note or marke, then turne the Globe, and reckon the degrees of the Equator that paſſe vnder the Meridian, vntill ſo many be paſt as was your obſeruation, there againe holde the Globe ſtedie, and vpon your perallell cloſe by the Meridian, make your ſecond note or marke, then knowing the Sunnes altitude at both the obſeruations, you muſt bring the Quarta altitudo to the firſt note made vpon your perallell, there holding the globe ſtedie, the Quarta altitudo and marke agreeing in altitude, bring the quarta altitudo to the ſecond note, if that doe alſo agree with your former obſerued altitude, then doth the Globe ſtand in his true Eleuation: if not, you muſt eleuate or depreſſe the Pole by diſcretion, vntill you bring the two obſerued altitudes of the Sunne, to agree with the two markes which you made vpon your deſcribed perallell, and then is the Pole at his true eleuation: and what is ſpoken of the Sunne, the like may be done by any knowne fixed Starre. I holde this concluſion to be very neceſſary, pleaſant, and eaſie for the Seamans purpoſe.

To finde the true place of the Sunne in the Ecliptick at all times.

BEcauſe it is moſt neceſſarily required in the former practiſes, that the Sunnes true place in the Ecliptick be at all times knowne, I thinke it not amiſſe to enforme you how the ſame may be done.

The cheefeſt and moſt certaine meane to know the ſame, is by the tables of the Ephemerides, but thoſe tables wanting, the Seaman may in this ſorte doe it: by the Regiment ſeeke out the declination of the Sunne, that being knowne, bring the Zenith vpon the Meridian, ſo many degrees and minutes from the Equator as is the Sunnes declination, then moue the Globe vntill ſome degree of the Ecliptick doe come directly vnder the point of the Zenith, for that is the Sunnes place: you muſt further conſider, whether it be betweene March and Iune, for then you muſt finde the degree in that quarter of the Ecliptick, contained betweene ♈ and ♋: if it be betweene Iune and September, you muſt finde the degree in that quarter of the ecliptick contained betweene ♋ and ♎, &c. of the reſt.

It may alſo be knowne vpon the Horizon of the Globe by a Calender Circle that is there deſcribed, in this ſorte: firſt ſearch the day af your moneth wherein you deſire to know the Sunnes declination, and directly againſt

gainſt the ſame degree which ſtandeth for that day, doth alſo ſtand the degree of the Zodiac wherein the Sunne is at the ſame time, in a circle repreſenting the Zodiac, and deſcribed vpon the Horizon.

But if it be Leap yeere, you muſt not take the preciſe day of the moneth wherein you ſeeke the Sunnes place, but the next day following, and againſt that day ſeeke the declination.

To finde the Poles height by any two knowne fixed Starres.

WHen you ſee any 2. fixed Starres which you know to be both at one inſtant in the Horizon, vpon your Globe ſearche for thoſe Starres, and bring one of them to touch the Horizon of the Globe, if the other doe not likewiſe touch the Horizon, you muſt raiſe or depreſſe the Pole by diſcreete mouing of the Meridian, vntill you bring both thoſe Starres to be at one inſtant in the Horizon, for then the Globe doth ſtand to his true eleuation.

To finde the Poles height by any two knowne fixed Starres, an other way.

WHen you ſee any fixed Starre that you know to be in the Horizon, you muſt preſentlye take the height of ſome other Starre, that you likewiſe know, before the firſt be riſen from the Horizon, then vpon your Globe ſearch for the Starre that you obſerued in the horizon, bring that ſtar to yͤ horizon of the Globe, there holding the Globe ſtedy, bring the quarta altitudo to the other Starre, whoſe altitnde you obſerued, if it agree vpon the Quarta altitudo with the obſerued altitude, then the Globe doth ſtand to his true eleuation, if not, you muſt by diſcretion raiſe or lay the Pole vntill you finde the one Starre in the Horizon, and the other vpon his true obſerued altitude, for then the Pole doth ſtand to his true eleuation.

To finde the Poles height at all times by any 2. knowne fixed Starres.

WIth your croſſe ſtaffe take the diſtance of any 2. ſtarres from your Zenith, which muſt be done with as much expedition as may be, their diſtances ſo know, with a paire of Compaſſes meaſure ſo many degrees vpon the Equator, as is the diſtance of the firſt obſerued Starre, with an other paire of Compaſſes doe the like for the ſecond obſerued Starre, vpon the firſt Starre ſet one point of the Compaſſes that tooke his diſtance, and vpon the ſecond Starre ſet likewiſe one foote of the Compaſſes that tooke his diſtance, bring the other 2. feete of the Compaſſes to meet together, there make a marke, for that is the perallell wherin you be, and that marke is the Zenith, bring it to the Meridian by mouing the Globe, and there will appeere the latitude deſired, for ſo many degrees and minutes as that marke is from the Equator, ſo much is the Pole eleuated aboue the Horizon. This concluſion the Seaman ought to haue in good eſteeme.

To know the preciſe hower at all times, by the Sunne.

FOr the finding of the hower of the day by the Globe, it is neceſſary that the Poles height be firſt knowne, therefore ſet the Pole to his true eleuation, and the Zenith to his anſwerable latitude, then bring the place of the Sunne in the Ecliptick vnder the Meridian, there holding the Globe ſtedy, place the Index of the Ciclus horarius vpon 12. of the clocke or Noone, your Globe thus ordered, then with your croſſe ſtaffe take the Sunnes height from the Horizon, that being knowne, you muſt bring the place of the Sun to the Quarta altitudo, by mouing the Globe and Quarta altitudo vntil the place of the Sunne doe agree with the obſerued altitude, there holding the Globe that he moue not, the Index doth ſhew vpon the Ciclus horarius, the true hower deſired.

To finde the hower of the night by any knowne fixed ſtarre.

SEt the Globe to his true altitude, and the Zenith to his anſwerable latitude, you muſt alſo place the Index of the Ciclus horarius vpon the hower of 12. or noone, by bringing the Sunnes place vnder the Meridian, &c. as before you did by the Sunne, then take the height of any knowne fixed Starre, bring that Starre to the Quarta altitudo, by mouing the Globe and Quarta altitudo vntill the Starre come to his true obſerued altitude, there holding the Globe ſtedie, the Index doth ſhew vpon the Ciclus horarius the true time of your obſeruation.

To know the length of the daies and nights, at all times, and in all places.

THe place and time being giuen wherein you deſire to know the length of the day or night, firſt ſet the Globe to his true altitude for the place, then ſearch the place of the Sunne in the Ecliptick, for the time wherein you ſeeke the daies length, bring that place of the Sunne vnder the Meridian, there holding the Globe that he moue not, place the Index of the Ciclus horarius vpon the hower of 12. or noone, then turne the Globe vntil you bring the place of the Sun to touch the Eaſt part of the horizon, there holding the Globe, you ſhall ſee by the Index of the cyclus horarius, the true time of the Sunnes riſing, then bring the place of the Sunne to the Weſt parte of the Horizon, and you ſhall there ſee the true time of the Sunnes ſetting, wherby the length of the day day and night doth moſt plainely appeere. And this may ſuffiſe for the vſe of the Globe, neceſſary for the Seamans purpoſe.

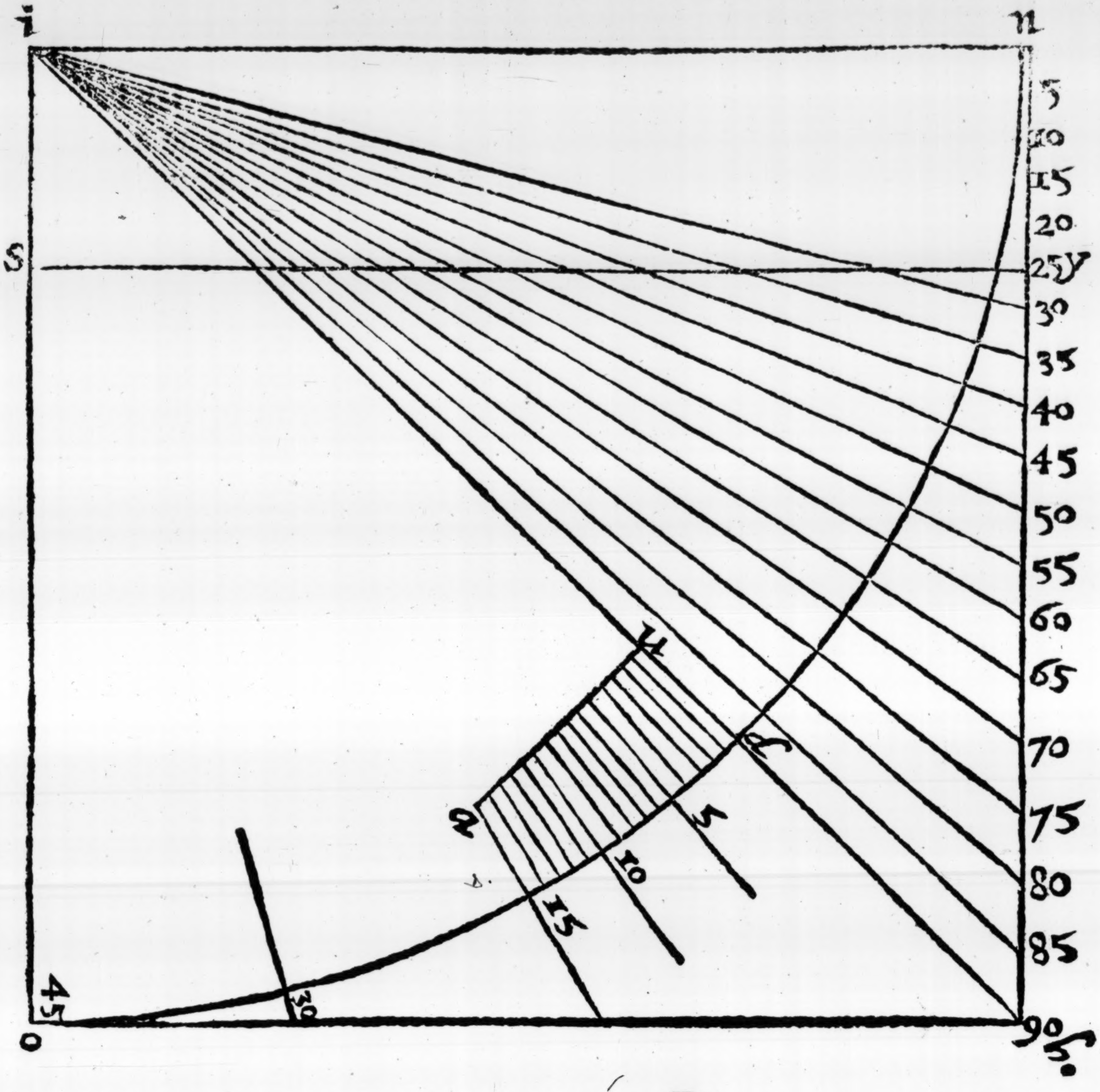
I might heere recite the triple riſing and ſetting of the Sarres, Coſinice, Acronyce, and Heliace, the aſcentions right and oblique, the dawning and twylight, howers equall and vnequall ordenary and planetary, daies naturall and artificiall, the triple riſing of the Sunne Equinoctiall and Solſticiall, Circles of poſition with their vſe and nature, the horoſcope and domifying diſtinctions of the heauens, the planets, their motions, retrogradiations, and excentricitie of their orbes, herologie, and many other moſt pleſant concluſions: but becauſe they doe in no ſort appertaine to the Seamans vſe, I I therfore omit them, as matters more troubleſome then profitable for him, expecting from ſome learned Mathematician a worke of worthy eſteeme, wherein theſe and many other excellent concluſions ſhall by cunning demonſtration be made knowne vnto vs.

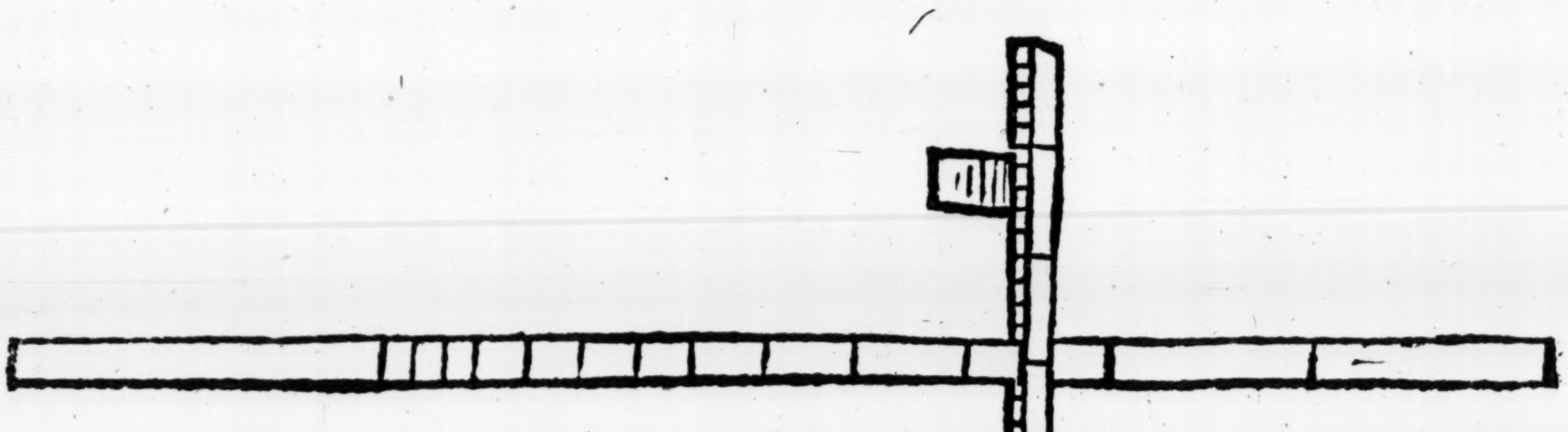
Of the Croſſe ſtaffe and his demonſtration.

THe Croſſe ſtaffe is an artificiall quadrant, geometrically proiected into that forme as an inſtrument of greateſt eaſe and exacteſt vſe in Nauigation, by which in any naturall diſturbance of wether (the Sunne or Starres appecring) the Poles height may be knowne, when the Aſtrolabie or quadrant are not to be vſed. Conueying the vſe of the quadrant from the beame of the Sunne to the beame of the eye, for whereas by the quadrant the Sun beame perceiuing the Dioptra ſheweth his height, ſo by the Croſſe ſtaffe the beame of the eye conueyed to the Sunne or Starre, doth likewiſe giue their height. The demonſtration whereof is thus.

Make a plaine ſquare conſiſting of 4. right angles, as is the ſquare, I. o. h. n. the angle I. ſhalbe aſſigned the Center of the quadrant, where placing one foote of your Compaſſes, ſtretch the other foote to the angle n. and therewith deſcribe a quarter of a circle, as is the arke o. d. n. then from the center I. to his oppoſite angle h. drawe a right lyne, by which lyne the quadrant o. d. n. is deuided into 2. equall partes, in the point d. deuide the arke d. n. into 90. equall partes, drawing from the center I. lines through euery of thoſe diuiſions touching in the line n. h. as by this figure appeareth: then conſider the length of your tranſuerſary, and take halfe thereof laying it vpon the lyne I. o. in the point S. from that point S. drawe a perallell to the lyne I. n. as is the lyne S. Y. and as that lyne doth interſect the diuiſions of the halfe quadrant, ſo ſhalbe the degrees of the croſſe ſtaffe, and note that the ſides of the ſqare, muſt be as long as the ſtaffe that is to be graduated.

Becauſe

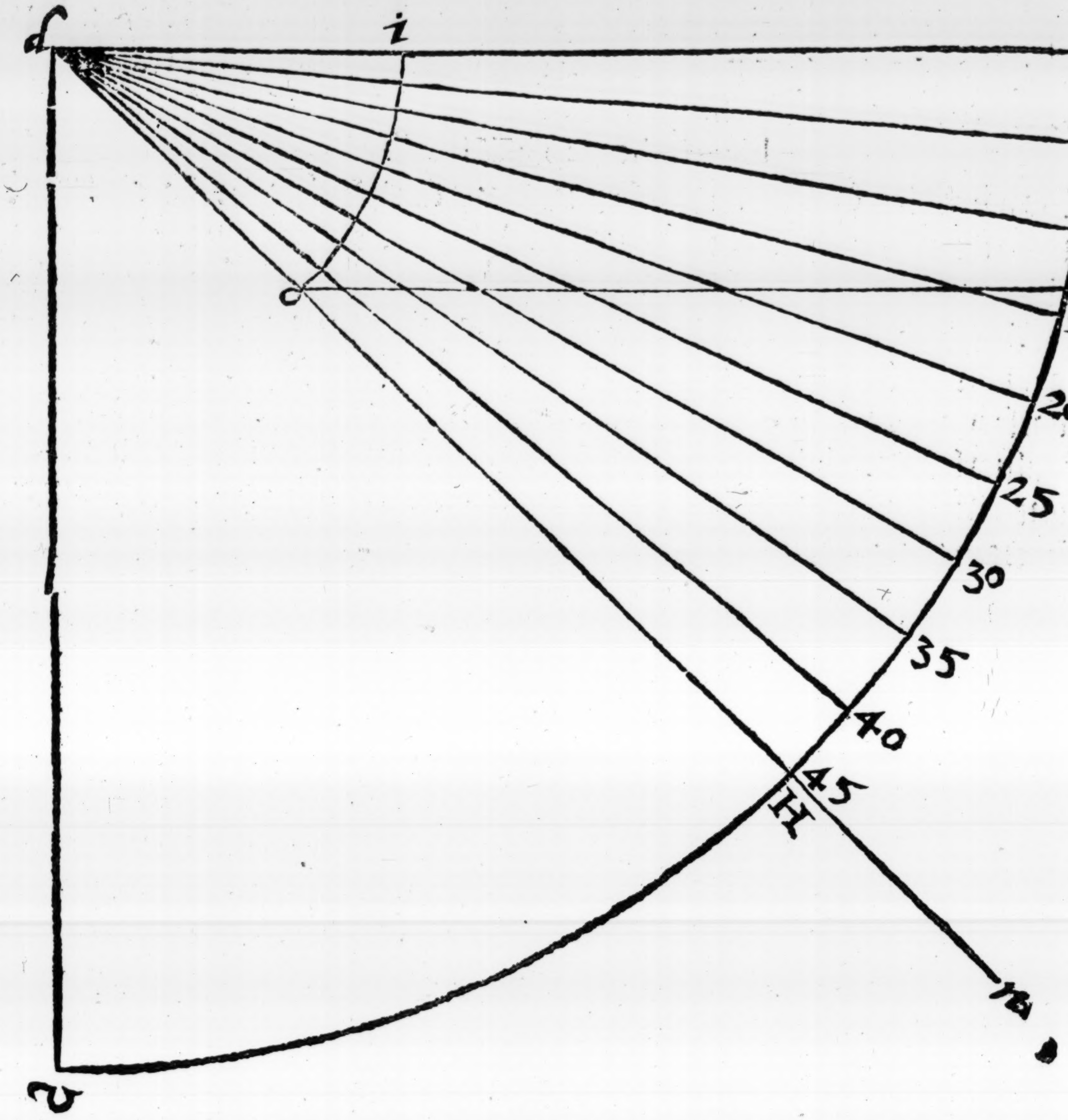


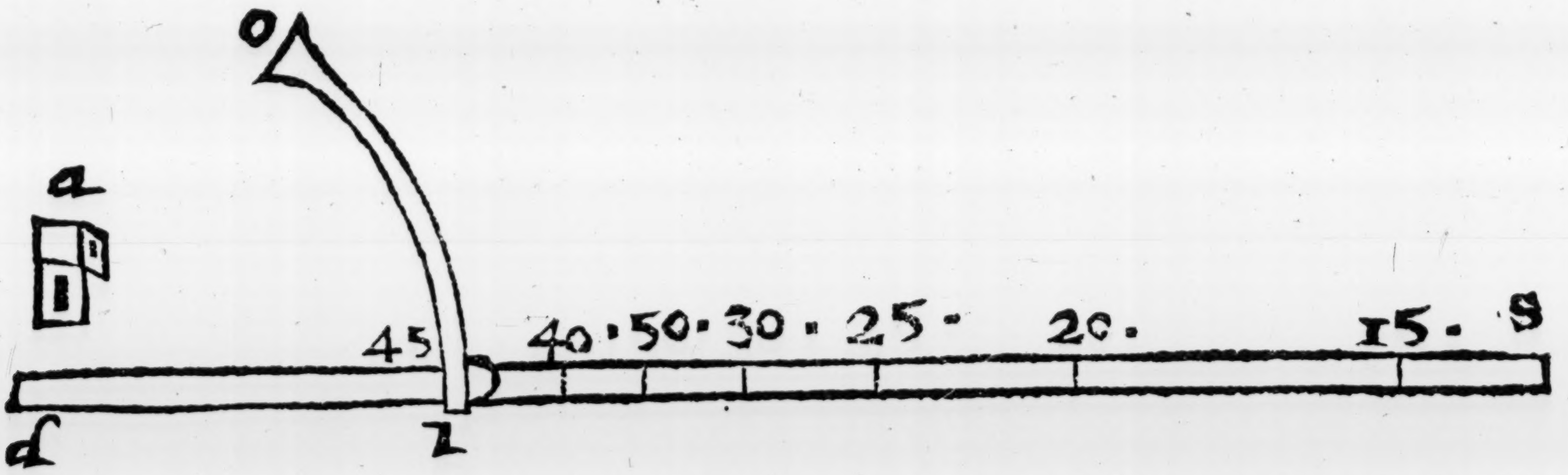


Becauſe the ſtaffe ſhould be of vnreaſonable length to contain more then 60. degrees, therfore to keepe him in due forme for the eaſe of his vſe, and that the complement of 90. degrees ſhould be contained vpon the ſtaffe, the other 30. are artificially proiected vpon the tranſuerſary, as by this demonſtration appereth, and in this ſort conſider the length of your ſtaffe from that point S, to the laſt interſection which endeth in 30. degrees, lay downe the length vpon the line I. h. at the point v. from that point drawe a right line cutting the line I. h. to right angles, as is the line v. a. being iuſt the length of halfe the tranſuerſary: then deuide the arke o. d. into 45. equall partes, accompting from the point d. to the point o. then from the angle I. drawe right lines to the firſt 15. of thoſe partes, and as thoſe lines doe cut the lyne v. a. ſo muſt the tranſuerſary be graduated on both his partes, whereunto vanes being framed, your ſtaffe is finiſhed to your vſe.

There is a ſtaffe of another proiection, which I finde by practiſe to be an inſtrument of very great eaſe, and certaintie at the Sea, the Sunne not being more then 45. degrees aboue the Horizon, whoſe vſe is contrary to the other before demonſtrated, for by this ſtaffe the beame of the Sunne ſhadowing vpon the tranſuerſary, doth thereby giue the height moſt preciſelye, not regarding how to place the Center of the ſtaffe to the eye, for the correction of the parrallax of the ſight, and without looking vpon the Sun, whoſe demonſtration is thus.

Drawe 2. right lines, cutting ech other at right angles, as doe the lines d. v and d. s. vpon the angle d. deſcribe a quarter circle, as is the arke v. s. deuide that quadrant into 2. equall partes by the line d. n. cutting the quadrant in the point h. deuide the arke s. h. into 45. equall partes or degrees, drawing lines from the center d. to euery of thoſe diuiſions, then from the point I. being the third parte of the line d. s. vpon the center d. deſcribe an ark of a circle, as is the arke I. o. which is for the tranſuerſary of this ſtaffe, and and the line d. s. is for the ſtaffe, then from the point o. where the vpper ende of the tranſuerſary toucheth the line d. n. drawe a perallell to the line d. s. as is the lyne o. y. and as that line doth cut the lines drawne from the center d. ſo muſt the ſtaffe d. s. be graduated, laying it vpon the line o. y. putting that parte of the ſtaffe where the point I. toucheth, vpon the point o. and then from the point I. lay downe the degrees, as are the interſections vpon the line o. y. and ſo is the ſtaffe graduated.

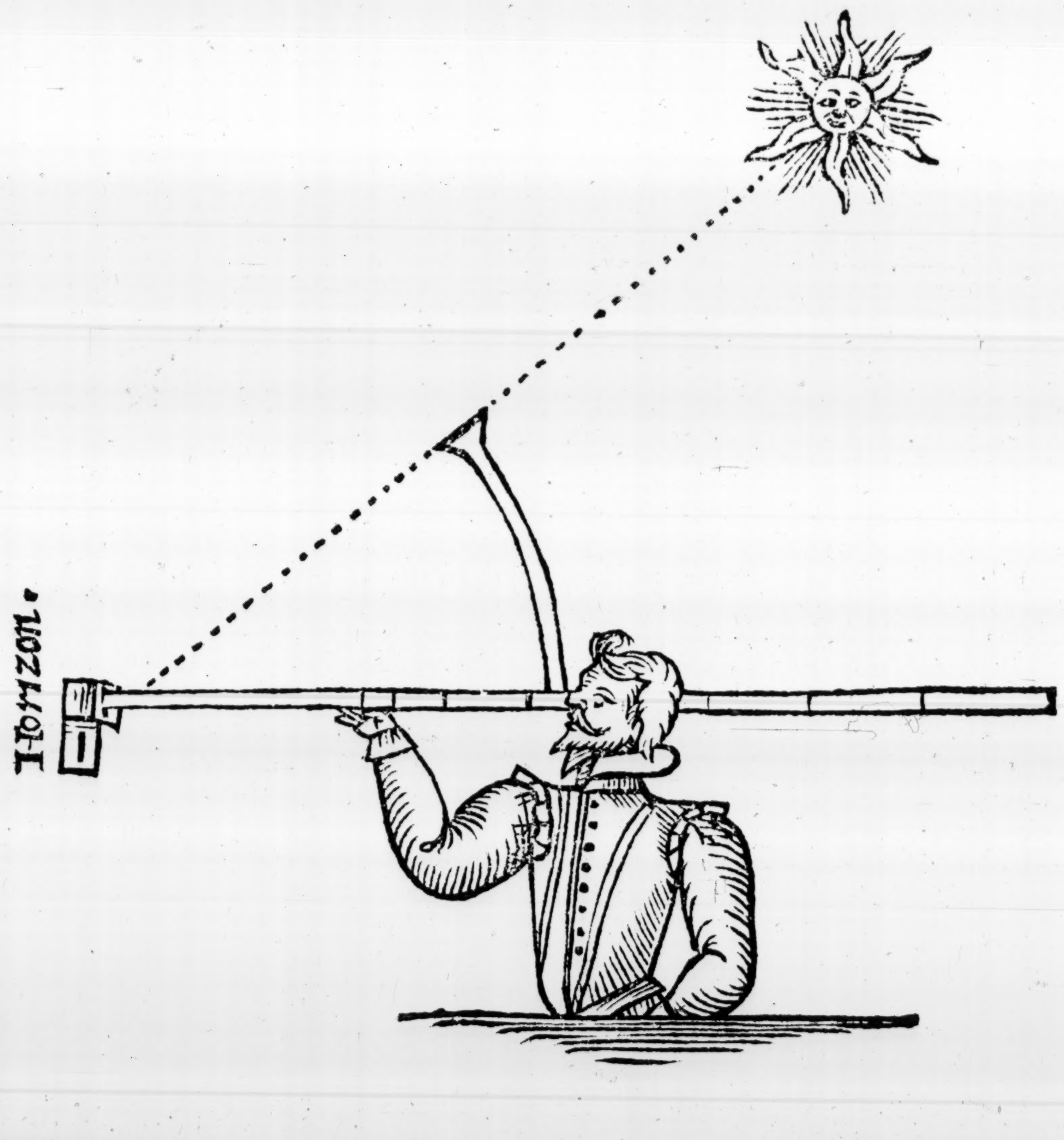




The tranſuerſary at the point i. muſt haue an artificiall hole made for the ſtaffe to runne in, as other ſtaues haue, alſo there muſt be a plate of braſſe with a ſoccat to be ſet to the center of the ſtaffe, as is the figure a, in the midſt whereof there muſt be a ſlitte, through which the ſight muſt be conueyed to the Horizon, and this plate muſt receiue the ſhadowe of the tranſuerſary, and ſo the ſtaffe is finiſhed.

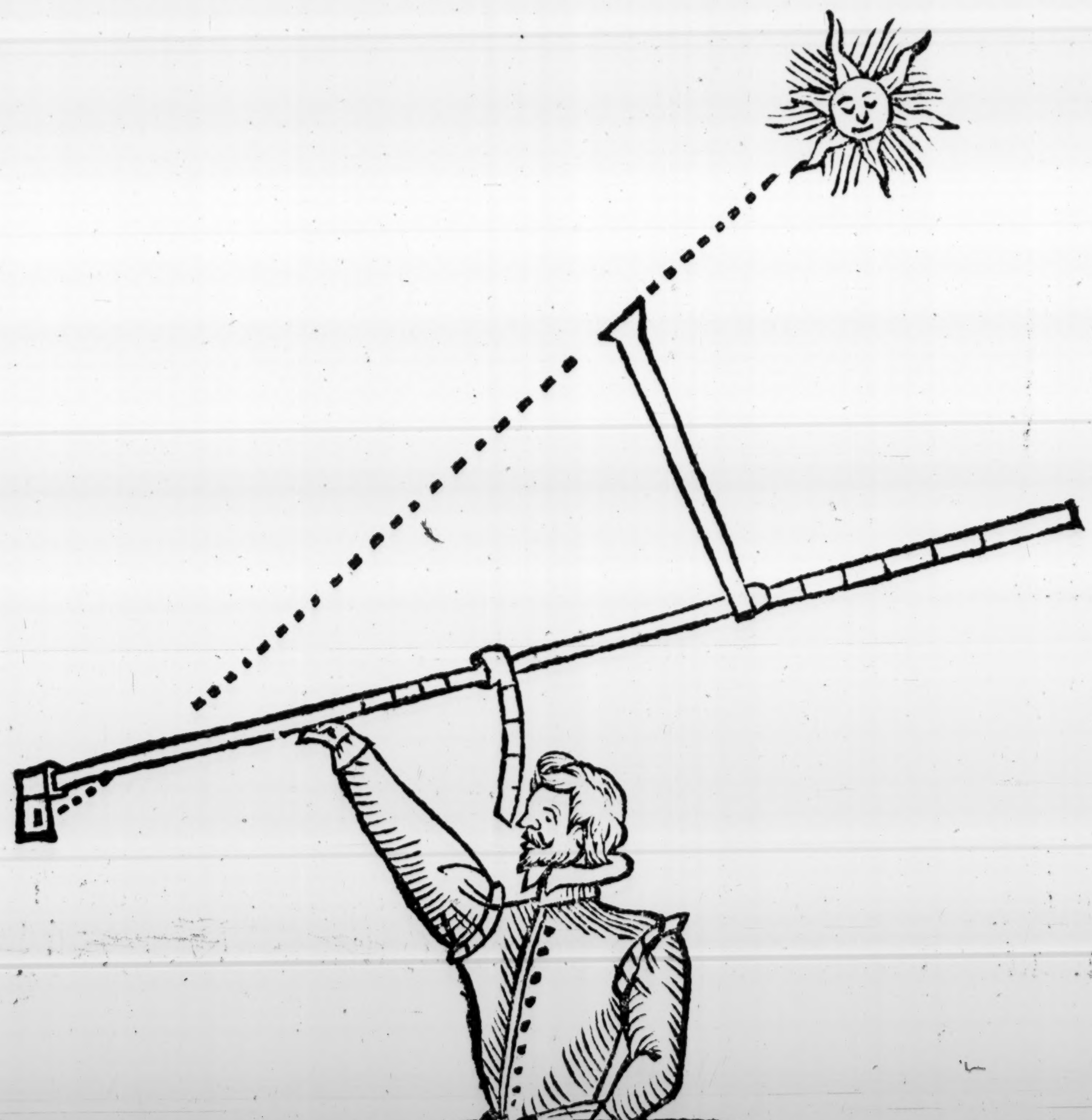
How is the vſe of this ſtaffe?

The vſe of this ſtaffe is altogether contrary to the other, for the center of this ſtaffe where the braſſe plate is faſtned, muſt be turned to that parte of the Horizon which is from the Sunne, and with your backe toward the Sunne, by the lower edge of the halfe croſſe, and through the ſlitte of the plate you muſt direct your ſight onely to the Horizon, and then mouing the tranſuerſary as occaſion requireth, vntill the ſhadowe of your vpper edge of the tranſuerſary doe fall directly vpon the ſaide ſlitte or long hole, and alſo at the ſame inſtant you ſee the Horizon through the ſlitte, and then the tranſuerſary ſheweth the height deſired.



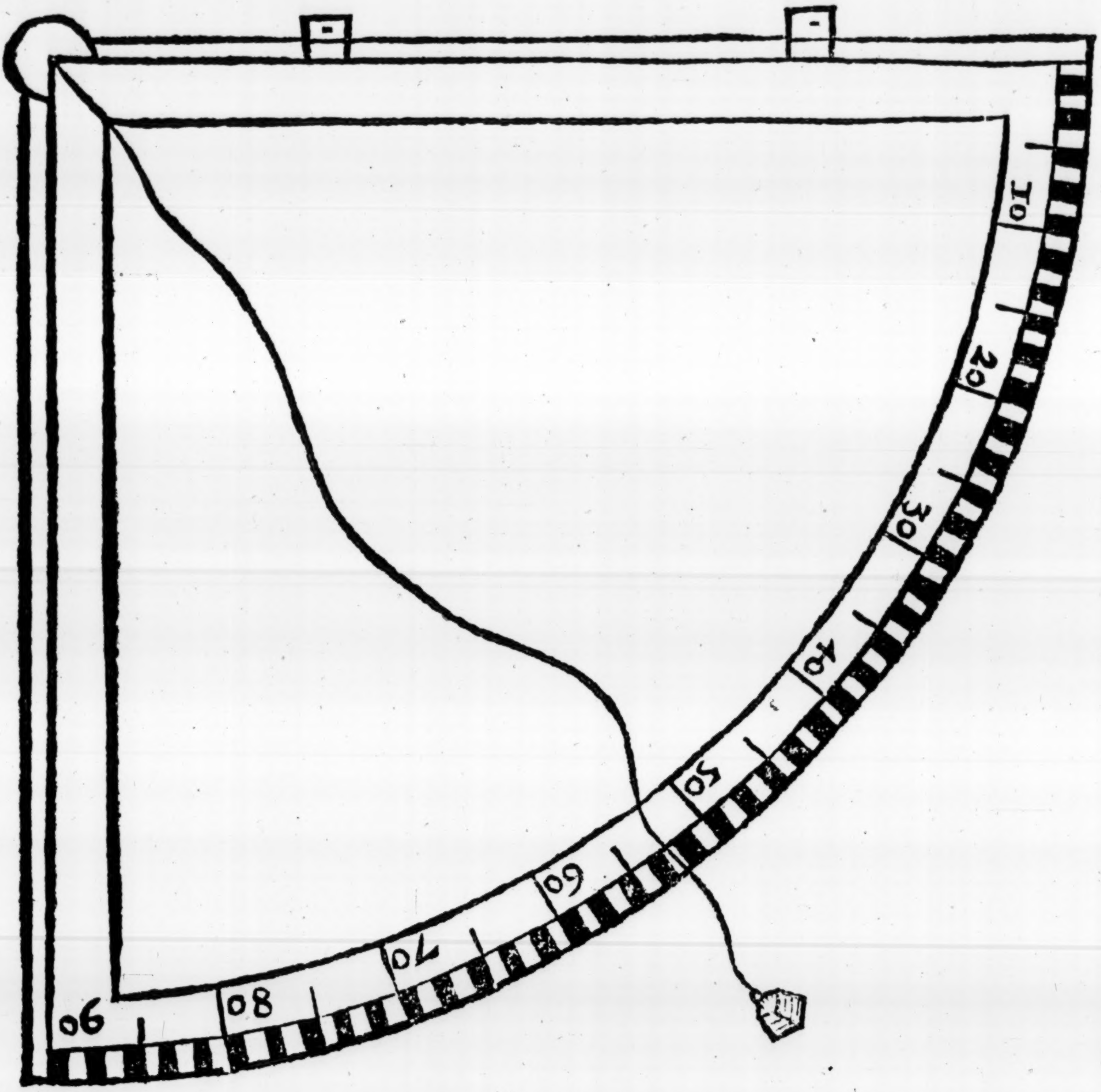
Finding by practiſe the eccellencye of the Croſſe ſtaffe aboue all other inſtruments to ſatiſfie the Seamans expectation, and alſo knowing that thoſe inſtruments whoſe degrees are of largeſt capacitie, are inſtruments of moſt certaintie. I haue very carefully laboured to ſearch a good and demonſtrable meane how a Croſſe ſtaffe might be projected, not onely to contayne large degrees, but alſo to auoide the vncertaintie of the ſight, by diſorderlye placing of the ſtaffe to the eye, which demonſtration I haue found, and haue had the inſtrument in practiſe, as well vnder the Sunne, as in ~~our~~ climates: but becauſe it hath a large demonſtration with manifolde vſes, I heere omit to manifeſt the ſame, purpoſing to write a perticular treatiſe therof, notwithſtanding his forme and vſe, by picture I haue thought good to expreſſe.

This ſtaffe is a yard long, hauing 2. halfe croſſes, the one circular, the other ſtraight, the longeſt not 14. inches, yet this ſtaffe doth contain the whole 90. degrees, the ſhorteſt degree being an inch and ¾ long, wherin the minutes are perticularly and very ſenſibly laid downe, by which ſtaffe not regarding the parallax of your ſight, nor looking vpon the Sunne, but onelye vpon the Horizon, the Sunnes height is moſt preciſely knowne, as well and as eaſily in the Zenith, as in any other part of the Heauen. Then which inſtrument (in my opinion) the Seaman ſhall not finde any ſo good, and in all Clymates of ſo great certaintie, the inuention and demonſtration whereof, I may boldly chalenge to appertain vnto my ſelfe (as a portion of the talent which God hath beſtowed vpon me) I hope without abuſe or offence to any.



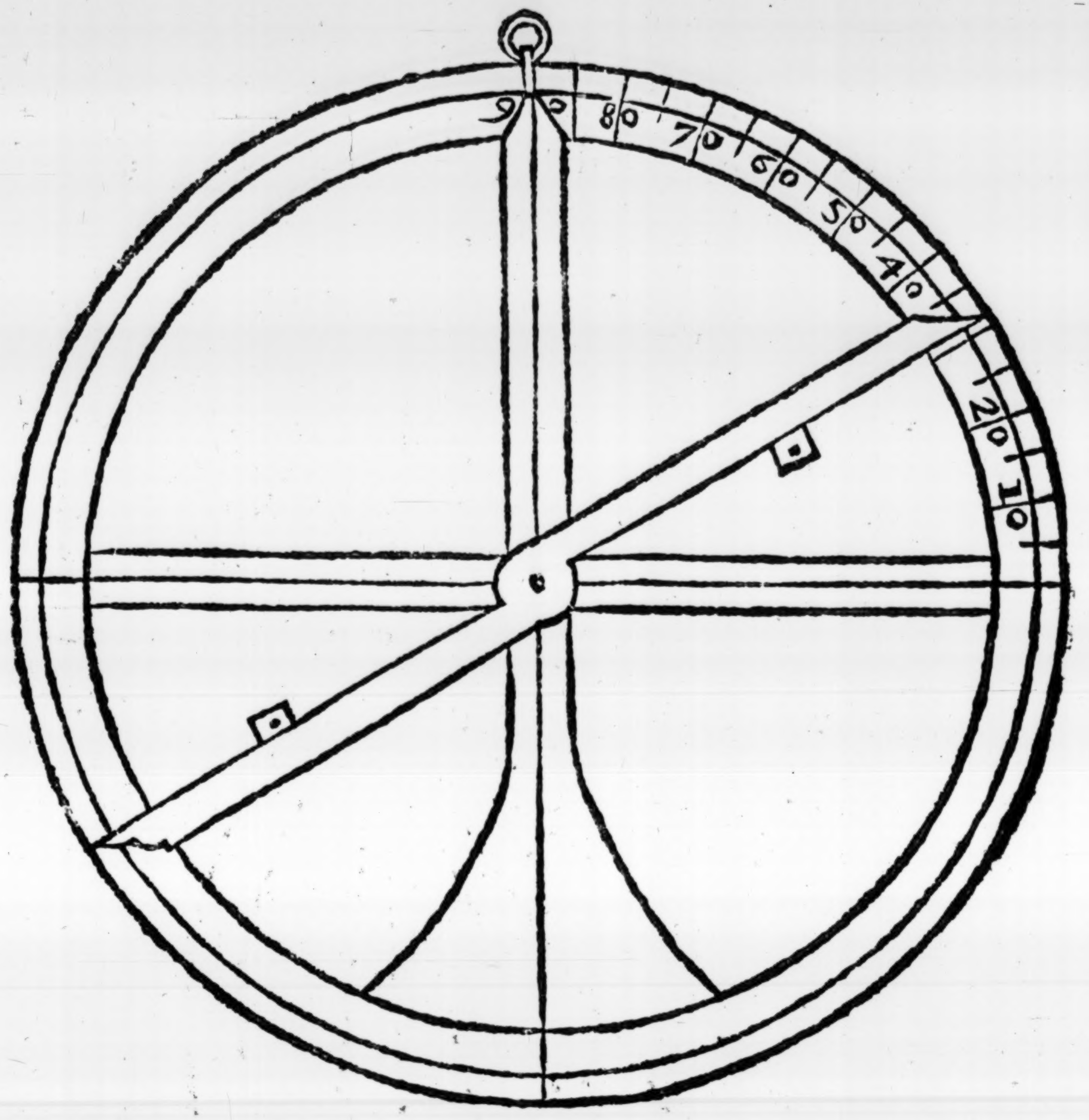
Of the Quadrant.

A Quadrant is the fourth part of a circle, containing 90. degrees, and repreſenteth the diſtance betweene the Horizon and Zenith, being an excellent inſtrument vpon the ſhore, to perfourme any Aſtronomicall obſeruations, but for a Seaman it is to no purpoſe: and although there may be very much written of the commodious and excellent vſes of the Quadrant, yet not being an apt inſtrument for Sea obſeruations, it ſhall be from my purpoſe to write further thereof, and therefore the onelye laying downe of his forme may at this preſent ſuffiſe.



Of the Aſtrolabie.

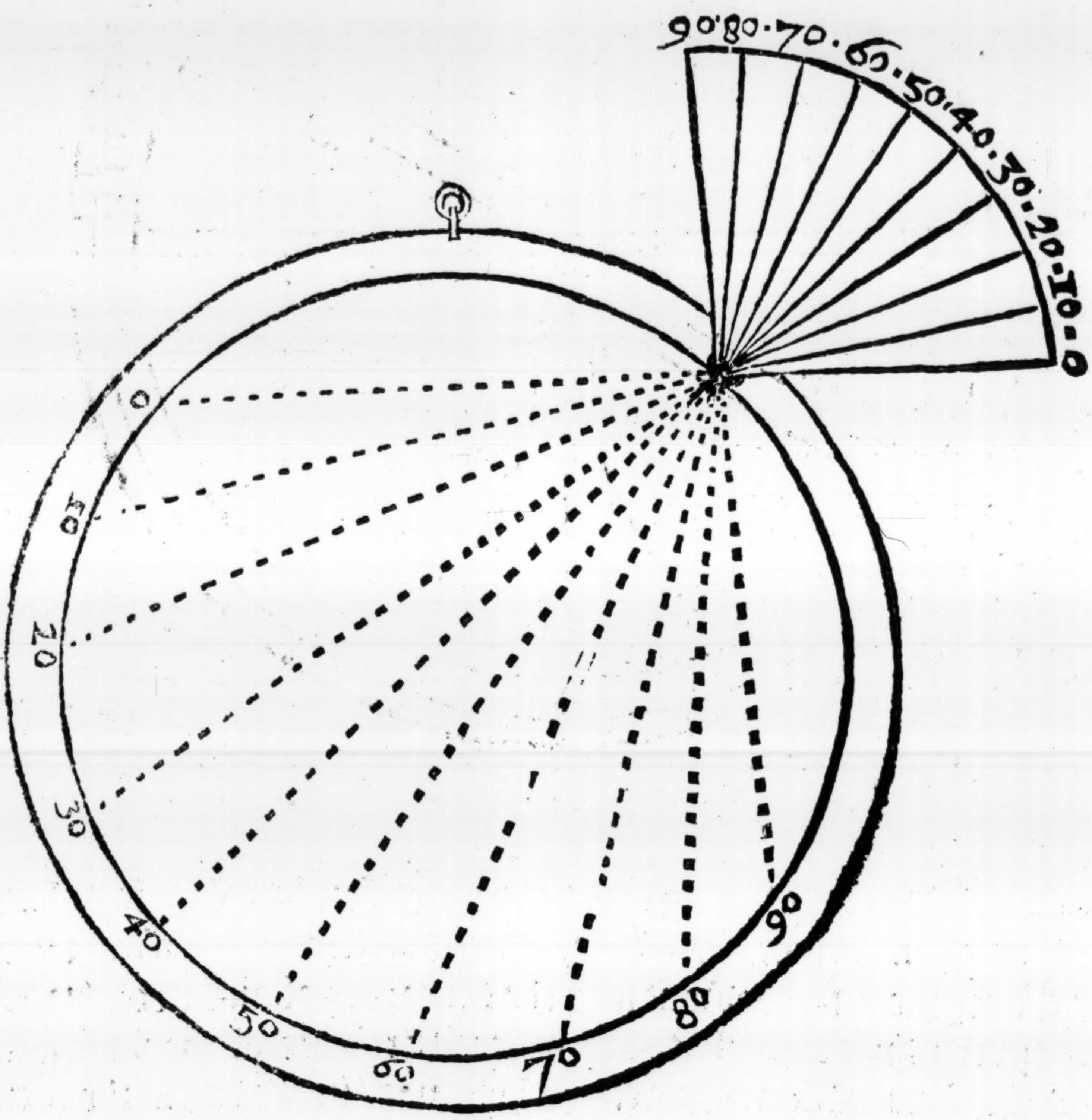
AN Aſtrolabie is the repreſentation of a great circle, containing foure quadrants, or 360. degrees, which inſtrument hath been in long vſe among Seamen, and is an excellent inſtrument being rightly vnderſtoode and ordered, but ſith the vulgare Aſtrolabie with his vſe is to euery Seaman ſufficiently knowne, it ſhould be vaine labour for me to lay downe his vſe and demonſtration: therefore by his fourme it ſhall ſuffiſe to expreſſe him.



There hath been great paines taken by many for the enlarging of the degrees contained in an Aſtrolabie, among which there is a proiection to conueye the degrees of a quadrant into the concauety of an Aſtrolabie, whereby thoſe degrees ſhalbe double, to any other Aſtrolabie of the ſame quantitie, ſo that the Sunne beame pearcing a hole made in the ſide of the Aſtrolabie, is thereby caried to the degrees noted, in the oppoſite concaue parte, as by his forme may appere.

Alſo my ſelfe labouring in the ſame matter, haue found a meane whereby an Ark of a quadrant whoſe ſide is 10. foote, may be conueied into an Aſtrolabie of 10. inches diameter, whoſe dioptra ſhall cut his lymbe to right angles, and ſhall perfourme the complement of 90 degrees, as amply and as effectually as by the quadrant it may in any ſort be done.

Whoſe demonſtration, together with the demonſtration of my Staffe, I purpoſe God willing, at large to manifeſt. But there can be no inuention that can eſtabliſh the certaintie of the vſe of either Quadrant or Aſtrolabie at the Sea, for vnleſſe it be in very ſmoothe water, there can be no certaintie of any obſeruation by thoſe inſtruments, whereby the Seaman may reſt aſſured of the la. which he ſeeketh, but the obſeruations made by the croſſe ſtaffe, are without all diſtruſt of errour, and therfore no inſtrument may compare with the excellencie of the croſſe ſtaffe for the Seamans vſe.



FINIS.

Imprinted at London at the three Cranes
in the Vintree, by Thomas
Dawſon. 1595.

VB